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AGRICULTURAL RESEARCH INSTITUTE
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PAPERS AND PROCEEDINGS

OF THE

ROYAL SOCIETY

OF

TASMANIA.

FOR THE YEAR

1910.

A. R. I. PUSA

Hobart.

d at "The Examiner" and "Weekly Courier" Offices,
73-75 Patterson Street, Launceston.

The responsibility of the statements and opinions given in the following Papers and Discussions rests with the individual authors or speakers; the Society merely places them on record.

Royal Society of Tasmania.

1910.

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Order of retirement from the Council in 1912, Messrs. E. L. Piesse, A. D. Watchorn, Dr. Clarke, Hon. Dr. Butler.

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Royal Society of Tasmania.

ABSTRACT OF PROCEEDINGS.

The Session of 1910 was commenced by the holding of a conversazione on the evening of March 31, under the presidency of His Excellency Sir Harry Barron, K.C.M.G., C.V.O. Among the visitors present were Lady Barron, Rear-Admiral Ijichi, and the other leading officers of the Japanese fleet visiting Hobart.

The proceedings were opened by an address from His Excellency the President. In the course of his remarks Sir Harry Barron said that for some years past it had been customary for the President to deliver a lengthy address at the first meeting of the Session for the transaction of ordinary business, but a recent alteration of the Rules had made it practicable for him to speak to those present in a less formal manner on the objects and work of the Society. A satisfactory increase in membership of the Royal Society had been made during the year, considering that the community was a comparatively small one. The Society had been founded through the agency of Sir John Franklin 70 years ago, and had steadily progressed ever since. Many very interesting papers on scientific subjects had been read during the year, one especially which dealt with the life and manners of the Tasmanian aborigines, being of great interest and value in a country like Tasmania, which had very little history. He might call attention to the provision in their Rules for the establishment of Sections for the purpose of encouraging the study of particular branches of science. It appeared that the Section of Medical Science was the only one now in operation. It was certainly desirable that Members should take up the work in which they were interested in this special manner, and better results would be thus obtained. His Excellency also referred to the necessity of research work being done in regard to the minerals and the soil generally, and also the necessity of re-afforestation, which was a matter of great importance. No doubt this was a new country, but it would be easy to predict what would happen if they did not take some steps to save the trees.

Lantern slides illustrating the geology and natural history of Tasmania were exhibited, and descriptions given by Dr. Noetling, Mr. T. Stephens, Mr. R. M. Johnston, Mr. A. L. Butler, and Mr. J. W. Beattie. Mr T. T. Flynn exhibited and explained some slides illustrating infusorial animalcules.

A number of objects of scientific interest were on view during the evening. Dr. E. J. Ireland showed some photographs of Samoan scenery; Mr. T. Stephens exhibited a fine specimen of Eozoon Canadense from the Lower Laurentian rocks of Canada; Dr. Webster, microscopic biological sections; Dr. Noetling, bathymetrical plans of Hobart harbour; Mr. T. T. Flynn, several microscopes and microtomes at work on biological material; Mr. R. Hall, microscope and mounted diatoms; Mr. H. M. Nicholls, microscope with mounted specimens of epizoa; Mr. A. L. Butler, eggs of the Australian black swan.

APRIL 11, 1910.

The Monthly General Meeting of the Society was held at the Museum on Monday evening, April 11, 1910.

His Excellency Sir Harry Barron, K.C.M.G., C.V.O., President, in the chair.

At the suggestion of the President, the Fellows present agreed to join him in sending a message of deep condolence to Sir John Dodds on the recent death of Lady Dodds.

APPOINTMENT OF VICE-PRESIDENTS.

The President notified his appointment of Messrs. T. Stephens, M.A., F.G.S., and R. M. Johnston, F.L.S., I.S.O., as Vice-Presidents of the Society for the current year.

ELECTION OF FELLOWS.

Messrs. Arthur S. Arundel, J. W. Beattie, W. H. Clemes, George A. Gurney, Harold Norman, and Rev. F. T. Morgan-Payler, were elected Fellows of the Society.

HONORARY MEMBERS.

On the recommendation of the Council, Professor T. W. E. David, C.M.G., B.A., F.R.S., and Professor Baldwin Spencer, C.M.G., M.A., F.R.S., were elected Honorary Members, Mr. T. Stephens and Mr. R. M. Johnston remarking that it was an honour to the Society to have associated with it two men who for many years had been such prominent promoters of scientific research, and who recently had distinguished themselves, the one by heroic service in connection with Antarctic exploration, and the other by his work among the aborigines of Central Australia.

NOTES AND EXHIBITS.

Major Foster exhibited some pictures and figure stones worked by the aborigines of Tasmania, and illustrating some of their practices and habits.

THE FOLLOWING PAPERS WERE SUBMITTED OR READ:—

1. Notes on the Publications of the Royal Society of Tasmania. By Fritz Noetling, M.A., Ph.D., etc.

2. The Antiquity of Man in Tasmania. By Fritz Noetling, M.A., Ph.D., etc.

The author notes the absence of the usual conformity in the evolution of the human race elsewhere, modern civilisation following immediately on the most typical archaeolithic stage that is known to us. The presence of the aborigines in the island necessarily, he thinks, implies former continuous land between Tasmania and Australia, though such connection is proved to have existed by evidence of a totally different nature. The theories of previous writers are discussed, and the conformation and submarine topography of Bass Strait are described in detail, with suggestions as to the various stages assumed at different periods by the connection of Tasmania with the mainland of Australia. The paper is illustrated by plates showing in elaborate detail the author's researches and conclusions respecting the submarine physiography of Bass Strait and the records of glaciation.

Mr. Ritz wished to know what evidence there was that the Tasmanian aboriginal came from anywhere at all. The language of these aboriginal races was so simple that he was led to consider the autochthonous origin of the aborigines.

Mr. R. M. Johnston complimented Dr. Noetling on his paper and the contour maps accompanying it. He agreed that Victoria and Tasmania must have been connected by land at one time. The close relationship of Victorian flora and fauna and that of Northern Tasmania in the tertiary period showed it. Undoubtedly Tasmania and Victoria had been repeatedly connected and disconnected. He believed that the Tasmanian aboriginals came from the north before the sea intervened, and subsequently the sea cut them off from the mainland, and so the ancient race of the mainland was preserved undisturbed, whilst on the mainland itself, subsequent mixtures with intruding and more aggressive races produced a higher race of blacks in Victoria.

Mr. A. J. Taylor said the Tasmanian aboriginals were very different in type of skull from those of the mainland, and had curly hair, whilst the Victorian blacks had straight hair.

Mr. T. Stephens said that the fact that Tasmania at one time formed a part of what is now the continent of Australia was an established fact, and it was highly improbable that the ancestors of the aborigines of Tasmania had any means of crossing the sea when what is now Bass Strait intervened. The period that has elapsed since their first arrival is, of course, a matter of speculation. The Tasmanian type is closely allied to that of the Papuan, and the original representatives of this race were probably gradually driven southward by the Malayan intruders until they turned at bay among the mountains of what is now Tasmania, and held their own among all comers.

3. On Certain Types of Stones used by the Aborigines. By H. Stuart Dove, F.L.S.

The paper contains a description of a number of worked stones collected by the author on the North-West Coast, and comprising two types of the so-called "hammer stones," the material of which they are composed being diabase.

MAY, 1910.

The General Monthly Meeting was not held this month, on account of the lamented death of His Majesty King Edward VII., Patron of the Society.

JUNE 13, 1910.

The General Monthly Meeting of the Society was held at the Museum on Monday evening, June 13, 1910.

Mr. R. M. Johnston, F.L.S., I.S.O., a Vice-President, in the chair.

ELECTION OF FELLOWS.

Messrs. J. S. Purdy, M.D., C.M., D.P.H., F.R.G.S., A. Kirk, D. Salier, H. Holt, and Thos. J. Steele were elected Fellows, and Mr. A. M. Lea an Associate of the Society.

NOTES AND EXHIBITS.

Mr. A. O. Green submitted notes taken at Bellerive at the time of the recent eclipse of the sun, of which the following is an abstract:—

"At 3 p.m. the whole sky was overcast with small soft clouds coming from the N.N.E., though the sky was somewhat lighter in the N. and in S.W. and S. By 3.50 p.m. it grew perceptibly darker, the dusk increasing, the temperature falling, birds silently flying into trees. A newspaper could be read with ease at 4.7 p.m. From 4.14 to 4.20 p.m. it was too dark to write, and all the while the clouds showed a bluish tinge. At 4.18 p.m. it was possible to read again, and the clouds were slightly tinted orange. At 4.29 p.m. the yellow-tails and white-eyes were chattering in bushes, and at 4.40 p.m. the yellow-tails were singing. A steady rain commenced at 4.40 p.m., lasting till 8.30 p.m., when the sky cleared in the N.W. At 3 p.m. the thermometer showed 59.8deg.; at the time of the first contact (3.10 p.m.), 58.9deg.; the temperature gradually fell till 4.10 p.m., when 53.3deg. was recorded. The totality lasted from 4h. 14min. 12sec. to 4h. 17min. 6sec., and at 4.15 p.m. the thermometer showed 53deg. The minimum was reached at 4.40 p.m., when 52deg. was recorded, and then there was a slight rise, the thermometer remaining at 52.1deg. from 4.45 to 4.55 p.m., while the last observation at 5 p.m. showed 52deg. again."

The Chairman exhibited a specimen of the mackerel of South-Eastern Australia (Scomber antarcticus). It was first described as a new species by Castelnau, who was one of the earliest observers of Victorian fishes. The present specimen came from Cape Raoul. Fish of this species often entered the Derwent in vast shoals, but he had never procured a specimen for 33 years. The fish was a very beautiful one, and an excellent one for the table. It was almost identical with the English mackerel.

THE FOLLOWING PAPER WAS READ:—

Comparison of the Tasmanian Tronatta with the Archaeolithic Implements of Europe. By Fritz Noetling, M.A., Ph.D., etc.

The author notes that this comparison gives they key to the understanding of the state of civilisation of the people of archaeolithic times. The character and manufacture of the tronattas is described, and it is noted that they were tools only, and never used as weapons. Conclusions are drawn from a study of their customs and habits as to the state of primitive man in Europe. The archaeolithic implements of Europe belonging to different periods are described at considerable length, and suggestions made as to the period when man, the ancestor of the aborigines, first occupied Tasmania. The paper was illustrated by the exhibition of a large number of specimens of archaeolithic implements from Europe, and some of the higher type, together with the primitive specimens from Tasmania.

Mr. W. E. Shoobridge said that the New Norfolk district was inhabited in former times by one of the largest tribes in Tasmania, the Big River tribe, and residents there now recognised two types of archaeolithic implements, one flat, and the other more rounded on the side. Old residents said that the flat ones were used for scraping spears. One specimen had been found which had a distinct handle or neck, which might have been used for fastening it on to wood. He had never seen any specimen chipped on both sides, and he had never seen anything resembling a spear amongst the implements which were found in his district.

Mr. T. Stephens said that great credit was due to Dr. Noetling for his researches in this complicated and interesting subject. He would suggest hat the complete isolation of the Tasmanian aborigines might account for the absence of progress and development. The intrusion of more civilised types from the north would have stimulated progress, but the Tasmanians were completely cut off from such influences. He regretted that so little was known about the habits of the Tasmanian natives before they came in close contact with Europeans.

The Chairman said that the Members of the Society had never before had such an opportunity of comparing the implements of the native Tasmanians with those of other primitive races. He agreed with Mr. Stephens that the probable reason the Tasmanians remained in such a backward condition was their complete isolation.

JULY 12, 1910.

The Monthly General Meeting of the Society was held at the Museum on Monday evening, July 12, 1910.

Mr. T. Stephens, M.A., F.G.S., in the chair.

ELECTION OF FELLOWS.

Mr. James Pillinger was elected a Fellow of the Society.

NOTES AND EXHIBITS.

Mr. Hall laid on the table a paper comprising a comprehensive and detailed description of the Moa bones in the Tasmanian Museum, which had been drawn up by Mr. H. H. Scott, a Fellow of the Society, for presentation to the Museum. The Chairman said that it was a curious coincidence that the only two gigantic three-toed birds of the family Struthionidæ—the Moa of New Zealand and the Dodo of Maurititus—both of them historically recent—had become extinct. Professor Owen saw at The Hague a picture painted soon after the Dutch acquired the island of Mauritius in which was a figure of the Dodo, evidently drawn from life. The Moa is supposed to have become extinct soon after the occupation of New Zealand by the Maoris.

Mr. Henry Holt exhibited specimens of internal parasites of domestic animals, including the Ascaris of the pig, the liver-fluke (Distoma hepatica) of the sheep, and specimens of Haematopinus from the pig and calf.

THE FOLLOWING PAPER WAS READ:

The Food of the Tasmanian Aborigines. By Fritz Noetling, M.A., Ph.D., etc.

The paper refers to the evidence of other authorities, including Ling Roth and the authors quoted by him, dealing generally with the question of animal and vegetable food. The author then proceeds to discuss the evidence of the vocabulary, describing in great detail the animals with which the aborigines were familiar and used for food, and passing on to their vegetable diet. He notes the great deficiency of carbo-hydrates in their food, and concludes that the excessive protein diet must have made them liable to disease, and probably accounted for the sluggishness of their brains.

Mr. Hall said that though the Pecten or common scallop was supposed not to be eaten by the aborigines, its shell had been found by Mr. May in their shell heaps.

Mr. A. O. Green said that he did not think the large fungus known as the native bread was ever eaten by the natives.

The Chairman said that in his early days in Tasmania he was often told by old settlers that the aborigines used to seek the Mylitta, or "native bread," for food, and pointed out the peculiar signs near the trunk of a dead tree which indicated its presence underground. When frequenting a rocky sea coast in the winter months they subsisted largely on the Haliotis. The debris in a cave at Rocky Cape which he had excavated to the depth of several feet consisted almost entirely of the remains of Haliotis shells. Dr. Noetling's researches in the question of the food of the aborigines had gone far beyond those of any previous writer on the subject.

AUGUST 8, 1910.

The Monthly General Meeting of the Society was held at the Museum on the evening of August 8, 1910.

Mr. T. Stephens, M.A., F.G.S., in the chair.

THE PETTERD COLLECTION OF MINERALS.

Dr. Noetling said that the collection of minerals which had been left to the Royal Society by the late Mr. W. F. Petterd, of Launceston, was a very valuable one, and would form one of the most important additions to the Museum that could be imagined. It would be of the greatest educational value, and if the Council of the Royal Society had not accepted the bequest, they would not have then been doing their duty either to the Members of the Society or to the public. The bequest should be accepted by the Society, even if they had to make some sacrifices to do so. The collection had been valued by the best experts at £1,212, and the probate duty upon it amounted to £121 4s. He would move:—"That this General Meeting of the Royal Society approves of the expenditure for the payment of probate duty, amounting to £121 4s., upon the mineral collection bequeathed to the Society by the late Mr. W. F. Petterd, of Launceston."

Mr. R. M. Johnston seconded the motion. The Council really had no choice but to act as they did, or take the risk of losing this valuable collection. Mr. Petterd was a native of Hobart, and no doubt was grateful to the Society for the aid that it had given him in his natural history and mineralogical studies in his early days, and therefore wished to secure his collection of minerals to Hobart as an acknowledgment. It was the best memorial he could have, that of good work well done.

Mr. L. Giblin said that on behalf of the Members of the Society he would like to ask for a little information as to how the finances of the Society stood; how it was proposed to meet the debt that had been incurred; and if it could be met without endangering the Society's journal. He also wished to know what further expense would be involved in the housing of the collection, and if there was room for it to be properly displayed? There was a valuable botanical collection—Gunn's collection—which had been languishing for many years in the cellars of the Museum for want of ability to display it, and he was wondering whether the Petterd collection was liable to be overtaken by the same fate.

The Chairman said that he believed that the payment of the probate duty on the collection would leave a slight debit balance. The Council were positively assured by those who were acting for the late Mr. Petterd's family that if this bequest was not accepted by the Royal Society it would go into the general estate, and could not be dealt with or administered until the youngest child came of age, which would be a good many years hence.

Dr. Noetling said that the Council had had to confer with the trustees of the Museum before the collection could be placed there, and the trustees had agreed that they would accept and suitably house the collection. There is ample room in the Museum, and plenty of cases which are now filled up with what may be called rubbish. If the rubbish is put in the cellar, the cases can be used for the exhibition of the Petterd collection. After paying for the printing of the Society's journal and current expenses it was expected that they would be £25 on the wrong side. He could assure the meeting that the Journal would not suffer.

Dr. Butler supported the motion, which was declared carried.

Dr. Butler moved:—"That the question of exhibiting the Petterd collection be considered at the next meeting of the Society, and that the Council be requested to bring up a report to that meeting as to the approximate cost."

Dr. Sprott seconded the motion.

The Chairman said that the first motion carried only committed the Society to the payment of the probate duty. Any further proposed expenditure would have to be brought before a meeting of the Society, and discussed and decided there.

The motion was carried.

SECRETARYSHIP OF THE ROYAL SOCIETY.

Mr. A. D. Watchorn, on behalf of the Council, said that a question had arisen as to the custody of a document in the possession of the Society, and it had become necessary for the Society to allow itself to be sued to enable the question of its ownership to be decided. The Society, according to the Act, could only be sued through its Secretary. As the office at present was non-existent, it was necessary to appoint a Secretary, and he moved that Mr. Bernard Shaw be appointed to that position, the office to be honorary.

Mr. E. L. Piesse seconded the motion, which was carried.

NOTES AND EXHIBITS.

Mr. L. Rodway exhibited a specimen of a plant not hitherto described from Tasmania. It grew on the Western Tiers, and had been identified by Professor Ewart, of Melbourne, as a new species of flax, and named by him Linum aloida. It differed in the structure of the flower from the common species of Linum.

Mr. Rodway also exhibited specimens of the wood of Eucalyptus Gunnii, which, in the Uxbridge district, where it reached a height of 300ft., was known as the yellow gum. It was a very valuable timber, and was locally used for mauls, on account of its toughness. The specimen of timber would be presented to the Museum for exhibition.

THE FOLLOWING PAPERS WERE READ.

1. Additions to the Catalogue of the Marine Shells of Tasmania. By W. L. May.

The paper furnishes a list of some 50 species of marine shells not hitherto recorded in Tasmania, some of which are probably new species, which were dredged by the author near Freycinet Peninsula in March, 1910, from depths up to 80 fathoms. He notes that in addition to these there were several known Tasmanian shells which have not previously been recorded south of Bass Strait, and remarks on the additional evidence obtained of the wide distribution of species on the Australian continental shelf, several species being taken which have recently been described from deep water dredgings off both Sydney and Adelaide.

2. The Distribution of Australian Land Birds. By Robert Hall.

The paper represents the views of the author as to the origin, migration, and distribution of the birds of Australia and Tasmania. He is of opinion that almost the whole of the present bird fauna had their source of expansion from the Papuan subregion. The paper is illustrated by a small map and diagrams.

SEPTEMBER 19, 1910.

A Special Meeting and the Ordinary Monthly Meeting of the Society were held at the Museum on the evening of September 19, 1910, having been postponed from the 12th instant out of respect for the memory of the late Mr. Bernard Shaw, Chairman of the Council.

SPECIAL MEETING.

The Special Meeting of the Council had been convened by the Council at the request of Mr. E. L. Piesse for the consideration of certain proposed alterations in the Rules.

Mr. T. Stephens, M.A., F.G., a Vice President, in the chair.

Mr. E. L. Piesse moved that the following be inserted after Rule 42:—1. "42a. At any General Meeting the Royal Society may authorise, on such conditions as may be arranged by the Royal Society or the Council, the affiliation with the Royal Society of any Society whose objects include any of the objects of the Royal Society." "42b. Any Society affiliated with the Royal Society may be allowed to hold its meetings in any room occupied by the Royal Society, on such terms and conditions as may be arranged by the Council." 2. That the following words be added as a sub-paragraph at the end of paragraph 44: —"Any other business that may arise."

In moving the amendment to Rule 42, Mr. Piesse said that the Rules of the Society provided for the formation of Sections, but there was no provision for connecting with them any body of persons interested in science who did not belong to the Society. It seemed to him that they should have a more elastic provision, so that they could associate other societies with them in their work. In large centres it was possible that kindred societies might work independently, but that was not possible in Hobart. They should be able to associate more closely with other societies. The occasion for making the proposal was known to all, as for some time the Field Naturalists' Club had been allowed to use the rooms of the Society, and under this arrangement much good had been done. The Council, however, recently discovered that they were infringing the Act by granting the privilege, and therefore it had been withdrawn. They regretted this very much, and he desired to find means to enable the club to continue to use the room. That was the main object of the motion, and he hoped to see it carried.

Mr. Giblin seconded the motion, and pointed out that it was not obligatory, but it gave the Society power to take certain action at a general meeting. He thought no harm could result from the innovation, but a considerable amount of good might be done.

Mr. A. L. Butler said he felt if the Society granted the Field Naturalists the privilege of affiliation it would be conferring a benefit on them, and would be forming a recruiting ground for the ranks of the Society in the future. Since the club had met in the Society's rooms they had derived a lot of benefit, and certainly no harm had accrued to the older body. It was very handy to the club to meet in rooms adjacent to the Museum, because it was essential that they should have the benefit of a collection of specimens in their work.

Mr. L. Rodway said he could not agree with the motion. He was a member of the Field Naturalists' Club, and he did not know that they were clamouring for affiliation. The Royal Society was an old institution, and they had run satisfactorily up to the present, and they should consider whether it was advisable to make the change at such a late hour in their life. The change might seriously interfere with the working of the Society, because, at an annual meeting, it might affect the voting very considerably. Hobart was growing, and keeping the societies separate would cause a good deal of healthy rivalry. It would be a great mistake for the Society to absorb into its ranks any other society that was working along the same lines, because it would be likely to hamper the work of the organisation, and cripple it generally.

Dr. Noetling endorsed Mr. Rodway's remarks, and said he was against the motion, because of the unlimited powers which it conveyed.

Dr. Butler said that there seemed to be an idea that the Society might be caught napping, and a catch vote secured on some vital point. That could be provided for by adding a few words at the end of the amendment, providing that notice of affiliation should be given at a meeting held some time previously. One thing that seemed to be overlooked was the great lack of interest taken in the monthly meetings of the Society during the last twelve months. The meetings were not well attended, and a great want of enthusiasm was displayed. In fact, it seemed that the Society was putting up a struggle against death.

Dr. Noetling: No.

Dr. Butler: Yes. Many times there were only a few members present, and they often had difficulty in getting a quorum. The proposal would tend to popularise their meetings, and he hoped to see it carried.

Mr. Piesse said he would accept the suggestion made by Dr. Butler, and would add a clause to his amendment, providing for a month's notice being given of any proposed affiliation.

The Chairman said that if he stood alone he would have to oppose the motion. A revision of the Rules was now being made, and the proposition would have to be referred to the Committee who had the work in hand, so that it would have to come up again for consideration when the general revision was discussed. The scope of the motion where it mentioned the affiliation of "any" society was altogether too wide.

The motion was put and lost. Including proxies, the ayes numbered 16 and the noes 27 votes.

Mr. Piesse said he would withdraw the new Rule 42b, but would ask the meeting to vote on the amendment to paragraph 44. The object of the amendment was to allow questions to be asked or subjects to be discussed of which notice had not been given. At a previous meeting of the Society a question had been asked, but it was ruled out of order, and he wanted to safeguard the procedure in the future.

Mr. L. Giblin seconded the motion. He held that the present condition of affairs was absurd, and was never contemplated by the framers of any rules.

Mr. R. M. Johnston said that there would be great danger in passing the motion. If it was passed it was possible for all sorts of matters to be introduced which were altogether foreign to the proceedings of the Society. Recently politics had been touched upon in their ranks, and some of them were not of the best form. It would be a bad thing if they were to split up the Society into interests, and lead to the introduction of parties. The object of the Society was to encourage original work, and the publication of papers written by Members. He considered that the passing of the motion would cause rivalries to spring up, and would defeat the objects of the organisation.

The Chairman said he would ask the mover of the motion if he wished to convert the Society into an ordinary debating society? That would be the result of the motion, for all sorts of subjects would be sprung upon them for discussion without notice. It appeared to him that the object aimed at could be sufficiently attained under the present Rules. He sympathised with the object of the motion, but would have to vote against it in its present form.

The motion was lost. Including proxies, the ayes numbered 10 and the noes 31 votes.

This concluded the business of the Special Meeting.

The Monthly General Meeting of the Society was then held. Mr. T. Stephens, M.A., F.G.S., in the chair.

THE PETTERD COLLECTION.

A communication was received from the Council enclosing a letter from the Trustees of the Tasmanian Museum offering to take charge of the Petterd collection of minerals provided it was placed in their charge on loan for 999 years.

Dr. Butler expressed pleasure at the fact that finality was at last being reached in the matter. Had any delay occurred there was a possibility that the collection would have been lost to Hobart and to the State. It was a matter for regret that the collection was not bequeathed to the Museum, as all difficulty would thus have been got over at once.

Mr. R. M. Johnston moved that the collection bequeathed to the Royal Society of Tasmania be lodged in the Museum in accordance with the terms of the Museum trustees' letter.

The motion was seconded by Mr. G. Brettingham Moore, and carried.

APPOINTMENT OF DELEGATE.

Nominations were received for the position of delegate of the Society to the Annual Meeting of the Australasian Association for the Advancement of Science, to be held in Sydney shortly. As the result of a ballot Mr. W. H. Twelvetrees, Government Geologist, was elected as the Society's delegate.

THE NORMAN VOCABULARY.

The manuscript recently discovered among the papers of the Society containing the vocabulary compiled by the Rev. James Norman, of Sorell, from his intercourse with the aborigines of Southern and Eastern Tasmania, was ordered to be printed.

THE LATE MR. BERNARD SHAW.

The Chairman referred to the loss that the Society had sustained by the death of Mr. Bernard Shaw, who was Chairman of the Council for the last two years, and had rendered valuable services to the Society. The deceased gentleman had won the love and respect of all the Members. The Trustees of the Museum had decided to place on record some memorial of Mr. Shaw, and it had been suggested that the Society and the Trustees should send a joint message of sympathy to Mrs. Shaw.

The suggestion was unanimously adopted.

OCTOBER 10, 1910.

The Monthly General Meeting of the Society was held at the Museum on the evening of October 10, 1910.

Mr. T. Stephens, M.A., F.G.S., a Vice-President, in the chair.

SECRETARY OF THE ROYAL SOCIETY.

Dr. Fritz Noetling was appointed Secretary of the Society, for the purposes of Section V. of the Royal Society Act, 18 Vict., No. 4, in the place of the late Mr. Bernard Shaw.

NOTES AND EXHIBITS.

The Chairman exhibited specimens of the Tasmanite shale from the Mersey district. The volatile part of the shale was of purely vegetable origin, and derived from the spore cases of ancient club mosses, which were embedded in clay or sand. These shales formed part of the Mersey coal measure series, but their exact relationship to the Mersey coal seams was not quite clear.

Mr. Lea exhibited a specimen of a legless lizard of the genus Lialis, which looked remarkably like a snake, and two geckos, which he obtained in New South Wales.

Mr. R. Hall, Curator of the Museum, exhibited a specimen of the wombat, from Flinders Island. It was one of four specimens which were in Museums. Though originally found in all the islands of Bass Straits, it was now exterminated everywhere except on Flinders Island. It was a smaller species than of the mainland.

THE FOLLOWING PAPERS WERE READ.

1. Notes on the Norman Vocabulary. By Hermann B. Ritz, M.A.

The author remarks that this document is of great value, as containing what is probably the only vocabulary now extant in the original manuscript, and a number of incidental notes written by the same hand, these notes being very interesting in themselves, and specially so because they do not seem to have been incorporated in any of the published accounts of the customs of the aborigines of Tasmania.

Dr. Noetling said that the paper upon which the manuscript was written was hand-made, and bore the name of the manufacturer, and the date 1827. The information given by the Rev. Jas. Norman was very interesting, but parts of it should be taken wth some criticism.

The Chairman said that the Rev. Jas. Norman arrived in Tasmania in 1827, and had been appointed to the charge of Sorell in 1832. He remembered Mr. Norman himself, having met him on the occasion of his first visit to Sorell, in 1864.

Mr. W. E. Shoobridge said that he remembered the Rev. Jas. Norman, and knew that he took a great interest in the natives and their customs. Anything that he wrote on the subject would have been written from his own observations.

2. Notes on Eucalyptus Risdoni. By L. Rodway.

Mr. Rodway describes in detail the differences between that species and Eucalyptus amygdalina, the ordinary peppermint gum. The diameter of the fruit was the safest test as to the two species, but in E. risdoni there was a bluish bloom on the leaves, which was absent in E. amygdalina. In E. risdoni, however, there was an excessive variability, produced by varying surrounding conditions.

The Chairman said that Eucalyptus risdoni was almost invariably found growing on soils derived from the mudstone formation, an upper member of the marine permo carboniferous series, and the geological character of hills at a considerable distance might often be recognised by the bluish tint of the foliage of the trees growing on them. The relations of trees and plants to the soils on which they grew was one of the most interesting studies in botany.

3. Notes on the Genus Lissotes, with Descriptions of New Species. By Arthur M. Lea, F.E.S., Government Entomologist.

This paper is illustrated by plates, and was made interesting by the exhibition of a fine collection of specimens.

4. Skin Diseases treated by Blood Vaccine. By E. W. J. Ireland, M.B., C.M.

The author says that the paper was intended to emphasise a possibility long recognised by the medical profession that skin diseases might originate in internal conditions, and that they might be successfully treated by the administration of vaccines prepared from cultures of each particular patient's blood.

Dr. Purdy said that he was inclined to think that the results which Dr. Ireland had claimed were largely due to psychical causes. In recent experiments tried in England remarkable results had been obtained by the subcutaneous injection of sterilised water, and it was no doubt due to the influence of the patient's mind over his body, and the influence of the physician over the patient's mind. If Dr. Ireland's results were borne out by further investigation, he had undoubtedly made a discovery, which would place him on a level with such men as Pasteur and Koch, but if the same results were produced by simple injections of water it would show that the phenomena were simply psychical. He gave instances of the remarkable results produced by suggestion.

Mr. A. J. Taylor said there was no doubt that suggestion formed the main feature in the Christian science treatment.

5. Weighing the Earth. By A. E. Blackman.

In the absence of the author, Dr. Noetling read this paper by Mr. A. E. Blackman, of Franklin, on the methods used in estimating the weight of the earth.

NOVEMBER 21, 1910.

A Special Meeting and a Monthly General Meeting were held at the Museum on Monday evening, November 21, 1910.

His Excellency Sir Harry Barron, K.C.M.G., C.V.O., President, in the chair.

The meeting had been convened by the Council on receipt of a requisition signed by five Fellows for the consideration of the following proposals:—"That the recent appointment of an

Honorary Secretary of the Royal Society be reconsidered after the lapse of one year, in the hope that meanwhile the Act of Parliament relating to the Royal Society may be repealed or amended, so that such an office as that of Honorary Secretary may become unnecessary in future, and that it be an instruction to the Council that they endeavour to bring about the necessary repeal or amendment."

Mr. S. Clemes, speaking on behalf of the requisitionists, submitted the motion to the consideration of the meeting. The present state of affairs needed some amendment in the direction proposed, because it was so cumbrous.

Mr. Clemes, junr., seconded the motion.

Mr. T. Stephens said that the Act of 1854 was practically a dead letter, having been superseded by the Act which made provision for the endowment of the Botanic Gardens and Tasmanian Museum, which originally were under the control of the Royal Society, but were surrendered by the Society to the State in 1885 in the interest of the public. The mistake made in not repealing the Act of 1854 when the Museum and Gardens Act was passed was now evident, when it had become necessary for the Society to allow itself to be sued in regard to the legality of the custody of a certain document, and the Society, so long as the Act of 1854 remained in force, had to be represented by a "Secretary" appointed under its provisions. The term "Honorary Secretary" should not have been used in connection with the matter, for the question of salary had nothing to do with it.

The President said that he had not had time to look into the Act, but there seemed to be some confusion about the titles of "Secretary" and "Honorary Secretary." It was desirable to clear up the exact position, and he would suggest that a small committee might be appointed to go into the question and report to a later meeting. It would be better to clear up the position.

Mr. Clemes said that that was what he hoped would be the outcome of the motion. He would be glad to move in the direction indicated by His Excellency.

On the motion being put it was carried without opposition.

The Monthly General Meeting of the Society then followed.

CORRESPONDENCE.

The Council forwarded a letter from Mr. Alfred Pedder, suggesting that portraits of the late King Edward VII. and the late Mr. Bernard Shaw should be obtained, and hung in the Royal Society's room.

Mr. T. Stephens said that the matter would not be lost sight of by the Council as soon as there were any funds available for the purpose.

NOTES AND EXHIBITS.

Mr. T. Stephens exhibited (1) portions of a joist and flooring board showing "dry rot," the species of which had not been determined. The underside of the board showed the delicate branching form of the mycelium of the fungus spreading from the rotted joist. The peculiarity of the case was its occurrence in the floor of a room not more than ten years old. The cause of it was the absence of the usual provision for ventilation by means of air-bricks. (2). A sample of the soil in which the bones of a gigantic extinct animal, not yet positively identified, were embedded in the Mowbray swamp, not far from Smithton, about three feet below the surface. The bones were neither decayed nor fossilised, and it would be interesting to ascertain by analysis whether there was any specially preservative element, such as that of European peat mosses, in the soil of the Mowbray swamp. (3). A somewhat rare fern found by Mr. Edward Stephens near the River Arthur, and identified by Mr. Rodway as a species of Aspidium.

Mr. T. T. Flynn exhibited three species of tunicates—Salpa, Appendicularis, and Pyrosoma—which had been obtained in dredging trips undertaken by the Field Naturalists' Club, and stated that they had not previously been recorded for Tasmania.

THE FOLLOWING PAPER WAS READ.

New Marine Mollusca. By W. L. May.

The author remarks, speaking of the Marginellas, that recent dredgings in our deeper waters, from 40 to 100 fathoms, have brought to light a great number of new forms, some of which are very distinct species, whilst others vary so greatly in both form and size as to make them exceedingly puzzling, and that the object of the present paper is to attempt to bring some order out of chaos. In the second part of the paper 14 new species are described, and it is illustrated by plates.

The Minerals of Tasmania

By W. F. Petterd, C.M.Z.S.

Read June 14, 1909.

THE MINERALS OF TASMANIA.

By W. F. PETTERD, C.M.Z.S.

INTRODUCTION.

It is the earnest desire of the compiler of this revised Catalogue of the minerals known to occur in Tasmania to make it such that it may be advantageously referred to for information on the subject of the great variety of beautiful, useful, and scientifically interesting minerals which have been, or are now, recorded as occurring in this island. The descriptive articles respecting the occurrence and peculiarities of the more important have been rewritten so as to embody the latest information as to association, crystallisation, and paragenesis of the respective species. As might be expected, much of the matter is necessarily collated from general sources, but a considerable portion may be taken as original, more particularly that which treats of localities. This may be attributed to the unusual opportunities enjoyed by the writer, coupled with the facilities afforded by several friends who have been induced to interest themselves on the subject. Although written in as simple language as the subject permits, it has been assumed that the reader has at least a slight knowledge of the subject dealt with.

The last Catalogue of the minerals known to occur in Tasmania was published in 1896. Since that year a considerable amount of work has been accomplished by various observers, and a careful record has been kept with a view to still further elucidating the mineralogy of this island, primarily from a purely scientific standpoint, and to a certain extent from the inseparable economic aspect; but as the context will clearly show, the Catalogue is essentially a compilation for handy reference by those interested in Tasmanian mineralogy.

In explanation of its production, it may scarcely be necessary to mention that to the modern geologist the science of mineralogy is of ever-increasing interest, as its methods are still further applied to the elucidation of the igneous and other rocks which constitute the earth's crust; while to the chemist the compounds which form the mineral species are a never-ceasing field of observation and interest on account of their homogeneous combination and peculiarities of crystallisation. During the past few years a comparatively large amount of serious petrographical work has been accomplished with regard to Tasmania in correspondence with the progress of investigation in other parts of the world, with the result, as might be expected, of adding to this Catalogue many minerals of considerable scientific interest. The important thesis of Dr. F. P. Paul* on the singular, and to some extent unique, igneous alkaline complex of Port Cygnet and the rocks of the Shannon Tier has been an important factor in adding several heretofore unrecorded species of essential and accessory rock-forming minerals to those already known to our lists. The interest taken in and the assistance rendered by that veteran in petrographical science, Professor Rosenbusch, of Heidelberg, has not only stimulated research in petrology and its resulting mineralogy, but has confirmed or otherwise the labours of our local workers.

The exploitation of several mining localities, which were practically in the early days of their inception 13 years ago, when the last compilation was published, has materially extended our knowledge of the mode of occurrence, affinities, and genesis of many of the then appreciated species, as well as added to the number of metal-bearing minerals with which we were at that time acquainted. These remarks more notably refer to the cupriferous minerals of the Lyell mining field, the lead-zinc mines of the Mt. Read and Rosebery fields, and the varied metallic minerals and their associates which recent investigations have shown to occur in the Middlesex, Heazlewood, and Bischoff districts.

To the mineralogist the secondary derivatives from the metallic ores, although as a rule of no great commercial importance, have a peculiar fascination owing to the duplex aspect of their generally beautiful colouration, and because in many instances they present perfect examples of natural crystallisation. In addition, their modes of occurrence, origin, and geological relationship are to the observant fascinating studies, and in this record an endeavour has been made to show that even the metal-bearing minerals, primary and secondary, have much in themselves worthy of careful attention, strictly outside of their intrinsic value, important as that may be. It may not be out of place in this connection to emphasise that the study of mineralogy does not necessarily mean mining, practical or speculative, although mining unquestionably includes dealing with minerals. It more properly refers to an attempt to elucidate their structure, chemistry, associations, and geological occurrences. In fact, the vast bulk of what are termed species of minerals, or those which have received distinctive appellations, are absolutely without intrinsic value. It may be said, without danger of a serious perversion of fact, that of the enormous number of mineral substances which are already known to science, not two per cent. have any direct or indirect commercial importance; but as products of Nature's handiwork all are worthy of the study and attention of the chemist, the petrologist, and those interested in natural science. The mineralogist is always engaged in revelling in the mysteries of his study, yet it is ever evident that each fresh discovery still further impresses him with the fact that there is yet more to learn, even about what are apparently the most simple substances.

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* Beiträge zur petrographischen Kenntnis einiger foyaitisch-theralitischer Gesteine aus Tasmanien. Tschermak's Mineralogische und Petrographische Mitteilungen. Band 25, Heft IV., Wien, 1906.

Any explanation of the larger and more abstruse subject of the genesis of ore-deposits has not been seriously undertaken, as that is a task for the advanced specialist, who would need much collateral information, both local and scientific, on which to formulate any rational theories as to the varied conditions which govern the deposition of minerals in the different classes of lode formation and filling.

From the last published Catalogue several species have been eliminated, either because their occurrence in this island has not been confirmed, or that their presumed identification was in error; but to compensate for this a large number—considerably over 100—have been added. Some few of these had been overlooked, but the greater number are the result, as already indicated, of investigation during the past few years.

The number of species and varieties of minerals herein referred to is approximately 330, which may be regarded as a remarkably large number, considering the comparatively restricted area of the island. Although this number may, and doubtless will, be augmented as investigation proceeds, it is reasonable to suppose that we now possess a fair knowledge of the mineralogy of the State, thanks to the services rendered and encouragement given by willing helpers.

The writer is under personal obligation for information to Messrs. R. Sticht, L. K. Ward, O. E. White, W. R. Bell, W. E. Hitchcock, and several others, who by giving localities and forwarding specimens have rendered valuable assistance, and it is to his friend Mr. W. H. Twelvetrees that his special thanks are due for so much kindly advice and help, which have materially lightened his self-imposed task.

January 18, 1910.

THE MINERALS OF TASMANIA.

1. Achlusite. (See Topaz.)

2. Actinolite *(Metasilicate of Calcium, Magnesium, with Protoxide of Iron).*

This is the comparatively abundant green-coloured fibrous variety of amphibole. It crystallises in the monoclinic system, the crystals being long slender prisms, which are remarkably brittle. It also occurs in fibrous aggregates which are often arranged in wedge-shaped masses, and occasionally assume an asbestiform character.

The radiating variety occurs a few miles south of the Hampshire Hills on the Upper Emu River. It is found associated with iron garnet, amethystine quartz, and fibrous radiating iron oxide, which is probably limonite. At the Heazlewood it is plentiful in spreading and radiating acicular bunches of considerable size and green colouration. Occurs in large masses on the River Forth, about 3 miles from Mt. Claude. On the Whyte River, near the base of the Meredith Range, this mineral occurs of a dark asparagus-green colour—much resembling the variety termed calamite—containing minute bunches of asbestos and particles of mountain cork, the whole closely intermixed with bands of a yellowish-brown garnet rock which rarely contains molybdenite. The mountain cork is of a spongy and closely-interlaced structure, pale-brown to brownish-green in colour, and is stained with iron oxide. At the Savage River it occurs in considerable abundance with cupreous pyrites and magnetite. At the Colebrook Mine, North-East Dundas, it has been obtained as very fine and beautiful radiating bunches, intermixed with axinite and pyrrhotite. At this mine it also is found in a semi-decomposed condition, with a little cuprite, and is at times encrusted with thin films of native copper. Well-developed crystals of axinite are commonly implanted and embedded in this association of minerals. It is plentiful at Barn Bluff in association with pyrites of various descriptions, and is often much decomposed, when it readily falls to pieces. At Dundas it occurs in limited quantity, but well developed, of a remarkably bright-green colour.

3. ADULARIA *(Polysilicate of Aluminium and Potassium).*

This is a variety of orthoclase felspar, which is also known as moonstone. It occurs in large crystalline masses porphyritically disseminated in granite. It is usually almost white, but varies to a pale-green colour.

Locality: Coldstream Rivulet, a tributary of the Huskisson River, and also at the Tasman Rivulet, with quartz of various forms (W. R. Bell).

4. ALBITE *(Polysilicate of Aluminium and Sodium).*

This triclinic soda felspar occurs in solid, irregular, subtranslucent, and compact masses, which are milk-white, at the Heazlewood River. It has also been detected in limited quantity in the mica-sölvsbergite of Port Cygnet and at Mt. Lyell.

5. ALMANDITE *(Orthosilicate of Aluminium and Iron).*

The common aluminium-iron garnet. Occurs in small crystals, which are translucent and of fair colouration, at North Mt. Heemskirk; near George's Bay in association with a dark-green chlorite; at Cape Barren Island embedded in quartz in considerable quantity; and at other localities.

6. AEGIRITE *(Metasilicate of Iron and Sodium).*

Also known as acmite. It is a monoclinic soda pyroxene corresponding to arfvedsonite in the amphiboles. It is peculiar to the alkaline series of igneous rocks. It occurs in connection with the Port Cygnet complex, and is specially conspicuous in the elæolite-syenite and sölvsbergite-porphyry of that locality, which has become noted amongst petrologists for its interesting series of igneous rocks.

7. ALLOPHANE *(Hydrated Silicate of Alumina).*

Found at the Savage River as irregular, fairly large masses, coated with a pulverulent white powdery substance of secondary origin. The colour varies from pale-yellow to a much darker shade. The general appearance of the mineral is remarkably gum-like. The composition is quite unusual, but there is little doubt about the identification.

Analysis by Mr. Watson, late of the Magnet Silver mining Company:—

		Per cent.
SiO_2	=	19·00
Al_2O_3	=	40·40
Fe_2O_3	=	4·70
CaO	=	·69
SO_3	=	1·61
Ignition	=	33·30
		99·70

Very characteristic samples of this amorphous mineral occur in reniform masses of a pale colour, almost translucent, and with a waxy lustre, at the Upper Forth.

8. ALUNOGEN *(Sulphate of Aluminium).*

Often abundant as an efflorescent powdery to fibrous incrustation in caverns and under shelving ledges, occurring in connection with saliferous rocks. It occurs near Bridgewater; Brown's River-road; near St. Marys; Mersey River, about 4 miles from Chudleigh, known locally as the Alum Cliff; Blue Tier, near Beaconsfield; and in other localities.

9. AMPHIBOLE GROUP.

This is an important group of rock-forming minerals which are almost exclusively confined to the Plutonic series; the exception being those sometimes found in true lava, *i.e.*, basalt and trachyte. They are chemically allied to the pyroxenes, but differ in the angular measurement, their cleavage, and their larger and more blade-like habit. The amphiboles may be termed the long, while the pyroxenes are the short, examples of a similar series of rock constituents, which closely approximate both in chemical composition and physical characters. The group, although so closely parallel to the pyroxenes, is less numerous in species, and so far as described the members also show less variety of form. They nearly all crystallise in the monoclinic system, the exceptions being anthophyllite, which belongs to the orthorhombic, and cossyrite to the triclinic, system. The various members of the group occur generally confusedly aggregated in habit, but may be fibrous or columnar in growth. In lustre they are vitreous to pearly on cleavage faces, opaque to translucent, and when massive extremely tough. They may be divided thus:—

(1) *With little or no Aluminium*—
Actinolite.
Asbestos.
Tremolite.

(2) *Containing Aluminium*—
Pergasite, or common hornblende.

The localities are under the respective headings.

10. ANALCITE *(Hydrous Silicate of Sodium and Aluminium).*

A zeolite that may be recognised by its isometric crystallisation. It is fairly abundant in the haüyne-porphyry of Port Cygnet and also in the Tertiary vesicular basalt at Bell Mount and vicinity. In the trachydolerite so prominent at Table Cape and Circular Head it occurs in groups of diminutive crystals. As small groups of well-formed crystals in basalt, Penguin River.

11. ANATASE *(Dioxide of Titanium).*

This mineral is also known as octahedrite. It is one of the polymorphous forms of TiO_2, the others being rutile and brookite. Anatase crystallises on the tetragonal system, the primary four being the octahedron with a square base. It assumes various shades of brown in colouration. It occurs in this island as diminutive waterworn crystals, and is extremely rare.

Locality: Clayton's Rivulet; near Hamilton, on the River Forth; near Mt. Lyell; and in the small streams in the vicinity of Brown's Plain.

12. ANDALUSITE *(Anhydrous Silicate of Aluminium).*

Occurs in slightly rhombic, four-sided prisms imbedded in rocks that have undergone contact metamorphism. It is very rare and undefined. The locality is uncertain. The variety chiastolite occurs sparingly imbedded in Silurian slate, as radiating and interlaced prisms of small size.

Locality: Near Zeehan.

13. ANDESITE *(Polysilicate of Aluminium, Sodium, and Calcium).*

This is one of the varieties of triclinic felspar that are intermediate between the species known as albite and anorthite. It is also termed andesine. As is usually the case with the felspar group, it is always of a pale shade of colour. It occurs as a constituent of the essexite of the alkaline plexus of Port Cygnet, and has been recorded from the Mt. Lyell district.

14. ANGLESITE *(Sulphate of Lead).*

Native sulphate of lead was named from its occurrence in the island of Anglesea. With other sulphates, it is formed by the oxidation of sulphides above water-level: that of lead being less soluble, it is often retained, while the sulphates of zinc, copper, and iron are dissolved and thus carried away in solution. Galenite is the natural parent of anglesite, and wherever that mineral has been shielded from the attack of carbonates, such as calcite, its oxidation results in the formation of this secondary mineral. It forms transparent to translucent crystals often beautifully formed, belonging to the orthorhombic system; the lustre is adamantine, and they are readily scratched by a knife. The mineral is often attached to decomposing galena or implanted on gossany limonite. Numerous specimens of exceptional size and perfection occurred at the Comet Mine, Dundas. The characteristic dagger-shaped crystals were of remarkable perfection, perhaps the finest ever discovered in the Commonwealth. They often had massicot implanted in the interstices, thus forming beautiful specimens for the cabinet. It occurs sparingly at the Zeehan and Whyte River silver-lead fields. At the latter some pretty rhombic prisms with sharp pyramidal terminations have been obtained, attached to the partially altered galena, and again on ferruginous gossan. At the Magnet Mine it has occurred of exceptional beauty, associated with crocoisite and pyromorphite, usually in the capping of the lode, well advanced in decomposition. It is often reported to assay somewhat high in silver, in which case that metal is practically intermixed in the form of a haloid.

Referring to the crystals of anglesite, Dr. Anderson writes ("Records of the Australian Museum," Vol. VI., Part 2, 1095):—"In the museum collection there is one specimen from this locality (Comet Mine, Dundas) consisting of a group of well-developed lustrous crystals in a vugh of galena, with powdery limonite. The crystals are of a general habit. . . . The crystal there represented measures 1·2 cm. × 1·9 cm.; it is slightly broken at the end of the macro-axis, and the *a* (100) faces are strongly striated parallel to their intersection with m (100). The predominant forms are c (001), a (100), and m (110); the others are very narrow. Two faces of a (102) admitted of measurement; but the pyramids and the dome o (011) were determined from single faces." Then follow the measurements.

"Clear, colourless, tabular crystals up to 2 inches in length and ¼-inch in depth occur at the Susannite Mine, between Zeehan and the Comstock, in the oxidised portion of a lode carrying a large proportion of pyrite." (L. K. Ward.)

15. ANKERITE *(Carbonate of Calcium, Iron, and Magnesium).*

This is a brown dolomite, differing from that mineral in containing a considerable proportion of iron. It occurs at the Heazlewood Silver-lead Mine, at the Comet Mine, at Dundas, and at the Magnet Mine, at all of which localities it forms no inconsiderable portion of the lode gangue. It weathers to a dark-coloured gossan at the outcrop of the lodes. At the Magnet Mine it is not unusual to find the ankerite and associated veinstone minerals much stained an apple-green by chromic acid, and the same applies in a lesser degree to the Heazlewood.

16. ANNABERGITE *(Arsenate of Nickel).*

A secondary substance, of a bright apple-green colour when pure. It is soft and commonly incrusting. It was detected in small quantity at the silver-lead mine at the Penguin, and is fairly plentiful, as thin coatings on niccolite, at a locality about 2 miles from Leslie Junction, Dundas.

17. ANTIMONY, Native.

Occurs in thin radiating patches, about an inch in diameter, implanted on a silicious matrix. A slab about a foot square was obtained practically covered with this element in the form indicated.

Locality: Spray Section, British-Zeehan Mine, Zeehan.

18. ANORTHOCLASE *(Polysilicate of Sodium, Potassium, and Aluminium).*

A triclinic potash felspar, whose primary form is an oblique rhombic prism. It is of a shining white colour It occurs in the sölvsbergites of Port Cygnet.

19. APATITE *(Phosphate of Calcium).*

This mineral crystallises in the hexagonal system, with pyramidal hemihedrism. It often occurs in the massive form, and it is mainly in this condition that it is mined commercially on the large scale. Apatite as a microscopic mineral is a widespread accessory of igneous rocks of almost all kinds; the micro crystals are mainly long hexagonal prisms, and it was evidently one of the first minerals in the rock-forming magma to crystallise. It occurs macroscopically of a clear greenish colour, with a dull lustre, and, in the amorphous slate, in limited quantity (mixed with the veinstone) at the old Hampshire Silver Mine; at Mt. Bischoff, as small pale crystals in the stanniferous topaz porphyry; in small crystals and crystalline particles in wolframite in the Bischoff Extended Mine; and as minute crystals, about 10 millimetres in length, of a pale pinkish colour, abundantly scattered throughout a stanniferous granite, at the Crystal Hill, Blue Tier.

20. ANTHOPHYLLITE *(Metasilicate of Iron and Magnesium).*

This is a rock-forming mineral of extremely restricted distribution, being mainly met with in Scandinavia. It is an orthorhombic amphibole which apparently bears the same relation to hornblende that enstatite does to augite. It is peculiar to the schists, and occurs as fibrous or bladed masses which are thin and without terminations. In habit they are commonly aggregated together in such a manner as to bear a strong resemblance to actinolite. It is usually of a pale-brown colour, varying to a darker shade, but may be still more rarely of a bright-green colouration. It has often a characteristic semi-metallic, glimmering lustre. In thin section under the microscope it shows unmistakably straight extinction and distinct pleochroism. It occurs as a schist upon a mineral section which was known as the Great Hercules, situated on the west flank of Mt. Read. The mineral in question is of a bluish-grey colour, with metalloidal lustre, and in habit is often aggregated together in bunches of irregular fibres and blades. The latter may be up to 1 inch in length, and sometimes show an irregular radiating structure. Anthophyllite schist also occurs at a locality known as the Black Bluff, at Cox's Bight, near S.W. Cape (L. K. Ward). The mineral is of a grey colour, with a somewhat metallic lustre, and occurs plentifully distributed throughout the rock in fine parallel blades.

21. APLOME *(Orthosilicate of Calcium and Iron).*

A garnet occurring in various shades of brown, but usually of a cinnamon colour. The crystals occur in considerable plenty and somewhat large size, often reaching above an inch in diameter. When freshly broken out of the matrix they are often well-developed rhombic dodecahedra with an attractive polish.

Locality: In the west bank of the Upper Emu River, near the Hampshire Hills.

22. ARFVEDSONITE *(Metasilicate of Sodium, Calcium, and Iron).*

A soda amphibole which is peculiar to nepheline syenite and rocks of the alkaline class. The only recorded occurrence is "a highly ferruginous variety of amphibole or black hornblende, containing 1 per cent. of copper. The copper which it contains exists in part or all as oxy chloride coating the crystals" (G. Foord).

Swan Island, Bass Strait (Gould, Pro. Roy. Soc., Tas., 1871).

23. ARAGONITE *(Carbonate of Calcium).*

This mineral is not by any means abundant in this State. It is dimorphous with and differs from ordinary calcite: which difference may be summarised as follows:—

Calcite—

Crystals, rhombohedral.
Specific gravity, 2·7.
Hardness, 3.
Deposited from cold solutions or from solutions containing alkaline silicates.

Aragonite—

Crystals, orthorhombic.
Specific gravity, 2·9.
Hardness, 3·5 to 4.
Deposited from warm solutions, or from solutions containing gypsum or strontianite.

The hard Tertiary basalt at Derby has afforded a few well-developed bunches of long slender crystals, showing acute pyramids occasionally radiating from the matrix. They occur in the vughs with zeolites and a little amorphous calcite. This mineral also occurs under similar conditions in the basalt of Middlesex, Mt. Bischoff, Sheffield, and Springfield. It is formed as stalactites in connection with the limestone caves at Chudleigh, Mole Creek, and probably in other localities of like nature. At the Magnet Silver Mine small and slender, but highly resplendent, crystals have been observed in the southern workings. They were implanted in irregular groups on sulphide ores. A small crystal, when tested with the blowpipe on coal, gave a minute bead of metallic lead, thus showing an approximation to the mineral which has received the name of tarnowitzite, from Silesia; but other examples from the same occurrence did not give this result. It may therefore be concluded that the replacement of portion of the calcium by lead was accidental, and that the proportion of the latter element was not sufficient to form the species referred to, presuming that in the Silesian occurrence it is a homogeneous compound, which is doubtful. At Bridgewater aragonite is found in connection with the lime quarries of the locality. Occasional bunches of irregular crystals occur in the dolomite of the Magnet with isolated crystals of remarkable length and purity.

24. ARGENTITE *(Sulphide of Silver).*

This mineral is only known in the crystallised form as rude, irregular octahedra and illformed cubes. Its common habit is in dendritic patches and earthy masses. It is only known under the name of "silver glance." It is an extremely uncommon mineral in this island. At the old Godkin Extended Mine, Whyte River, it has been found in an almost pure state, assaying at the rate of many thousands of ounces of silver per ton—as worn, rounded "slugs," intermixed with lumps of huascolite and galena. The slugs were of small size, rarely exceeding an inch in diameter, and were coated with a powdery black decomposition product. At the old Hampshire Silver Mine it occurred many years ago in the form of minute indistinct crystals implanted sparingly on other minerals and in cavities in the veinstone (W. R. Bell). At the Bell's Reward section, Whyte River, a few minute particles occurred in company with some embolite; they were scattered throughout a decomposed silicious matrix of doubtful origin. At an old mine at the Scamander River a small quantity was obtained in a silicious gangue with arsenopyrite. At the Magnet Mine small patches and scales occur in contact with highly argentiferous galena, and at the Spray Mine at Zeehan flakes of practically pure argentite have been detected implanted on siderite and other veinstone.

In Professor J. W. Gregory's report, entitled "The Mount Lyell Mining Field" (Aust. Inst. Min. Eng., Melbourne, 1905), the following paragraph occurs, which records the occurrence of argentite in association with chalcocite at the Mt. Lyell Mine:—"More important shoots of the richer ores have been found on the footwall side of the mine. The largest, known as the Mt. Lyell Bonanza, was discovered and worked out in 1904; it yielded 850 tons of ore, which was sent to London and sold for £105,000. This bonanza was found between the pyrites mass and the lower continuation of the hematite of the Iron Blow. It consisted of a vein of copper glance (redruthite $Cu^2 S$) and bornite, with fahl-ore and argentite (silver glance, $Ag_2 S$). It was found in a drive from the No. 4 tunnel. The entire shipment averaged 1011 oz. of silver to the ton, and one specimen which was knocked off by Mr. Lewis, the Attorney-General of Tasmania, and was assayed by the Tasmanian Government assayer, is quoted by Peters as yielding 8765 oz. of silver and 45 oz. of gold to the ton and 19 per cent. of copper. Some specimens assayed nearly 50 per cent. silver. As the vein was followed downward it increased in thickness, being in places 2 feet in width. The discovery of this body of rich ore was of great importance in the history of the field, as it had a considerable influence in securing the capital necessary for the development of the mine."

25. ARSENIC, Native.

In hemihedral crystallisations, with radiated internal structure; colour almost tin-white, tarnishing black.

Locality: East Bischoff Mine; in lowest level, North Valley lode, Bischoff, in blades between laminæ of siderite with fluorite, various pyrites, and black sphalerite (Ulrich).

26. ARSENOLITE *(Arsenious Acid or White Arsenic).*

A single lump was obtained at one of the old mines at the Penguin, associated with arsenical copper, melaconite, and a little native copper.

27. ARSENOPYRITE *(Sulpharsenite of Iron).*

This is better known under the vernacular name of "mispickel," and belongs to the class of sulphides sometimes termed the pyritoids. It is also known to miners as arsenical mundic. When struck with the hammer or pick, it emits the characteristic garlic odour of arsenic. It is isomorphous with marcasite, and like that mineral, crystallises in the orthorhombic system. It is the parent of many of the secondary minerals which follow its oxidation, such as scorodite and other arsenates which are formed by association with decomposed arsenides and sulphides containing copper and even lead. Mispickel is still mined in Cornwall and Devonshire, England, for the production of "white arsenic," which is obtained by roasting the crude material. In all tin-mining countries this mineral is abundant, as it is a constant companion of cassiterite, and is presumed to have been produced by the same solfataric and pneumatolytic agency. The emanations from an acid magma have been the cause of the alteration of granite and adjacent rocks through depositing this mineral with others so characteristic of tin lodes and pegmatites. As occurring in this island, it is usually in an amorphous condition, and when in the crystallised state the individual crystals are not so well-formed as those which have commonly occurred in other parts of the world. It is supposed to be a deep-seated mineral, as it shows vertical persistence in depth. At Mt. Bischoff it is too abundant from a tin-mining standpoint, as its contamination of the ore is a serious cause of trouble and expense. The same applies to other centres of the industry, notably at the Cleveland Mine, Heemskirk, and Mt. Rex. At Mt. Ramsay it is plentiful with native bismuth in amphibole; also at Mt. Pelion, south of the Surrey Hills block of the Van Diemen's Land Co. At the Penguin River it occurs in the old mines now abandoned. The analysis of the mixed ore from this locality is said to have given appreciable quantities of nickel, cobalt, and silver. At the goldfields of Mathinna, Lefroy, and Beaconsfield it occurs in the auriferous quartz reefs; on the southern slopes of Mt. Wellington a limited occurrence has been reported assaying up to 15 per cent. of cobalt; about Lyndhurst and east of Mt. Cameron it is abundant, and commonly highly auriferous; and at the Upper Scamander River is is equally abundant, and at this locality more often wholly or partially altered to scorodite. At the Magnet Mine it occurs sparingly, but in beautifully-formed crystals and trillings. At the Colebrook Mine it is found intermixed with axinite and pyrrhotite. At many other localities the mineral occurs, but does not, so far as known, present any features of special interest. Occurs as minute needles abundantly scattered throughout siderite gangue. Block 291, Ringville.

Analysis of the Mineral from this Locality.

		Per cent.
Fe	=	32·95
As	=	43·20
S	=	21·48
		97·63

with about 2 per cent. of antimony.

28. ASBESTOS *(Fibrous Amphibole).*

This variety of hornblende is also known as amianthus. It occurs in short silky bunches, associated with actinolite, in an adit driven on one of the abandoned mines at the Heazlewood. It also occurs in small quantity near Lynchford.

29. ASBOLITE *(Hydrated Oxides of Manganese and Iron, sometimes with Cobalt).*

This unsatisfactory combination has been found at the Godkin Silver Mine, Whyte River, in bluish-black bunches and irregular masses. Occurs in fair quantity at Dundas; Castle Forbes Bay; Magnet Range, in lode gossan with other secondary minerals; Castra, Upper Leven; Penguin River; Derby, rather abundantly, containing several per cent. of cobalt; and other places. When not containing cobalt this substance is often termed "wad."

30. ASPHALTUM *(Bitumen or Mineral Pitch).*

Occurs about 4 miles from Chudleigh, on east bank of the Mersey River. It is perfectly black, sectile, and burns with a dense smoke and strong odour. It occurs in a drab-coloured aluminous shale. "A species of it occurs on the north end of Prime Seal Island" (Gould, Pro. Roy. Soc. Tas., 1871, p. 61); also at Cape Barren Island. At various times somewhat large lumps of this substance have been washed ashore at this and other islands in Bass Straits, and also as far west as Table Cape. The pieces are at times several pounds in weight; their origin has never been discovered. As occurring in the Straits the material is of the purest quality, and would be of commercial importance if found in quantity. Tradition says that it has been used for the purpose of covering the bottoms of boats by the half-castes living on the islands.

31. ATACAMITE *(Oxychloride of Copper).*

This beautiful green ore of copper is occasionally met with in radiating acicular bunches in the vughs of ferro-manganese gossan ore capping the lode on the property of the Comet Silver-mining Company, Dundas; in small quantity in mixed oxidised ore, Silver Queen, Zeehan; and in vughs, Gad's Hill Range, Upper Mersey River.

32. AUGITE *(A Dark-coloured Variety of Pyroxene).*

The crystals of this mineral are usually, if not always, stouter proportionately than those of its ally, hornblende, and they are but rarely much elongated. In the basic rocks they are fairly developed.

Localities: St. Paul's Plains (Pro. Royal Soc. Tas., 1854)--in basalt, the crystals are often nearly half an inch in length; Paddy's Sugarloaf, Emu River; Hampshire Hills, near the Emu River; near Mt. Horror, in an intensely black basalt, on the weathered portions of which the crystals stand out from the surface of the rock: they are often very clearly defined.

"This mineral occurs abundantly in well-formed crystals up to a quarter of an inch in size in the basalt of the point of eruption near Hampshire Hills. (The Mt. Bischoff railway-train passes close to the right of this basalt hill going up.) Crystals can also be washed from the basaltic detritus on the slope of the hill. They mostly form twins according to the common law--twinning and composition plane the orthopinacoid." (Ulrich.)

The embedded crystals in the nephelinite of the Shannon Tier are of a shining black colour, and often of remarkably large dimensions, sometimes one inch and a half long. This monoclinic sub-species of pyroxene is an essential constituent in many volcanic rocks, such as basalts, as well as dolerite and other basic igneous rocks. It is almost always black or very dark in colour, and opaque. It commonly occurs crystallised, but may be in angular fragments, or even rounded grains, and is in some instances, such as in dolerite, of an ophitic character, clearly enwrapping the feldspathic ingredient. The crystals are generally small and imbedded, but on the exposed surface of the rock they are often prominent, and not rarely weathered out, as is the case with the occurrence at the Hellyer River.

33. AXINITE (*Silicate of Aluminium and Calcium with Boracic Acid*).

This mineral is of some interest crystallographically as a finely-developed member of the anorthic system, and chemically from its complex composition, which may be expressed by the equation $HCa_3\ Al_2\ BSi_4\ O_{16}$ where Ca is partly replaced by Fe and Mn. An analysis of the Tasmanian mineral from Colebrook gave the following result:—

		Per cent.
$Si\ O_2$	=	45·5
$Fe\ O + Mn\ O$	=	14·7
$Al_2\ O_3$	=	16·0
$Ca\ O$	=	18·8
$Mg\ O$	=	1·2
$B_2\ O_2$	=	3·0
Loss on ignition H_2O	=	·8
		100

Gravity, 3·23.

The late Professor Ulrich stated that "it is found in ill-formed tabular crystals of dark-brown colour and glassy lustre in the coarse-grained amphibolite of the bismuth mine, Mt. Ramsay. Apparently very rare. It fuses very easily before the blowpipe, and imparts to the flame the characteristic yellowish-green colour of boric acid. The borax bead is coloured amethystine in oxidation flame, becoming yellow in the reduction flame." In all probability the greatest discovery of this somewhat rare mineral hitherto recorded occurred at North-East Dundas, near Ringville, at the Colebrook P.A. Mine. At this locality occurs a remarkable association of axinite with various other minerals, which has been fully exposed by mining operations with a view to utilising the copper ores connected with the discovery. The crystals of axinite are as a rule very finely developed, with the edges highly modified, even much more so than the noted examples from the well-known classic localities of the Dauphine, France, and from Botallack, Cornwall, England. They are of a distinct and peculiar violet colour, of high lustre, and at times of large size. They occur intimately and irregularly associated with milk-white calcite, brown augite, pale-green spiculated actinolite, and more sparingly pale-green datolite, which last is often exceedingly well crystallised. There are also immense quantities of pyrrhotite, which commonly shows a remarkable play of bright colours—blue, red, and yellow; and a lesser amount of arsenopyrite and chalcopyrite, the latter sometimes superficially altered to native copper. The association, outside the metallic minerals, constitutes a mass which has received the rock name of limurite, and which has been fully described by Zirkel (N. Jahrbuch für Mineralogie, 1879). The occurrence at North-East Dundas is only paralleled by that of the original locality in the Pyrenees. The Tasmanian occurrence has been microscopically and macroscopically detailed by Mr. W. H. Twelvetrees and the writer (Pro. Roy. Soc. Tas., 1897, pp. 1-6, pl. *Loc. cit.*, 1898-9, pp. 1, 2, 56, and 59).

The following are excerpts from the papers referred to:—"Macroscopically the axinite is found in large lustrous crystal masses, the individual crystals often reaching half an inch in length, thus forming specimens of great interest to the mineralogist. The calcite is at times obtained in somewhat large masses, in which are often imbedded isolated crystals of axinite, which can be readily freed from the matrix by digestion in acids. The actinolite varies from felted aggregations of microscopic size to radiating collections of blades, occasionally some inches in length, in the latter case presenting unusually fine examples of the species. Various metallic minerals are found as accessory constituents, of which pyrrhotite is apparently most abundant; but pyrite, chalcopyrite, and more rarely leucopyrite occur in patches of variable size throughout the rock. These are decomposed on the surface to iron oxide, thin films of native copper, and small quantities of the carbonates of the same metal. In thin sections, when examined under the microscope, the bulk mass of the rock is seen to consist of axinite, actinolite, and calcite, with some hornblende. The other minerals appearing in lesser quantity are quartz, chlorite, tourmaline, and granular sphene." Details of micro examination: Axinite.—"This is in large irregular, and also sharply-defined crystals, in section of a pale-lavender colour to a deeper shade of the same tint. Interference colours, yellow, blue; sometimes interpenetrating twins. Cleavage-lines irregular. Pleochroism scarcely perceptible. The axinite has enclosures of quartz and fibrous hornblende, and has been replaced occasionally by clear quartz and vermicular chlorite, the latter light-green in colour, pleochroic, showing fixed dark cross, and polarising steel-grey. The quartz is very clear, and contains small prisms and needles of strongly-absorptive tourmaline. The tourmaline-bearing quartz is probably original, and the tourmaline may be looked upon as resulting from the same boracic acid emanations which were involved in the crystallisation of the axinite. Where the quartz is secondary, replacing axinite and augite, it contains long needles of actinolite. The axinite is in veins and massive patches, and is intergrown with datolite, danburite, and the other minerals of the rockmass. Professor A. Lacroix in his memoir on the limurite of the Pyrenees, is of opinion that the rock does not belong to a definite petrographical type, as it is variable in structure, and its mineralogical composition differs in different parts of the same mass. This remark applies with unabated force to the Colebrook intrusion, so far as the dyke as a unit is concerned. That there was a granite reservoir not far off is shown by the tourmaline quartz porphyry to the west at the South Renison Bell Mine, between which and the Colebrook is another occurrence of axinite, in the form of axinite quartz veins, on the West Coast P.A. sections, close to the granite. A slide prepared from this veinrock shows axinite, quartz, and an abundancy of leucoxene. It is noteworthy that the axinite is confined to the veinstuff, as in Cornwall, but there is no occurrence of limurite. On one of our slides we notice in the clear substance of our axinite some pale-green sub-spheroidal and polygonal translucent crystals, generally made up of rods or fibres somewhat curved, proceeding from the periphery to the interior. These remind one of the decomposition products of borocite called "parasite" by Volger, a hydrous magnesian borate. The wavy fibres are suggestive of some of the forms met with in precipitations from a saturated solution, and the phenomena seem to point to the existence of an excess of boric acid in the rock magma."

The crystals have been examined and described by Dr. C. Anderson, M.A., B.Sc. (Records of the Australian Museum, Vol. VI., Part 3), who states:—"From hand specimens in the museum collection it appears that the macroscopic associates of axinite are calcite chiefly in veins, chalcopyrite, pyrrhotite, actinolite in radiating aggregates, and datolite in crystalline masses. To this list Petterd and Twelvetrees, from microscopic examination, add chlorite, tourmaline, danburite, and sphene, while they find that the main mass of the rock is a pyroxene* which here and there receives accessories of axinite and other minerals, thereby becoming 'limurite.' The axinite occurs as well-defined crystals, sometimes reaching a length of 15 or 16 mm., imbedded in calcite or datolite, and disseminated through the pyroxene. It is not easy to find a detachable crystal suitable for the goniometer, and I am indebted to Mr. W. F. Petterd for the loan of three crystals, each fragmentary, but better than any in our collection, and adequate for measurement. The colour is clove-brown; the specific gravity, determined on a crystal weighing 1·0085 gram., was found to be 3·270. The habit recalls that of the Nundle and Moonbi axinite, the specimens having the same tabular extension parallel to *r* (111). Here, however, *ʒ* (112) is also a force of considerable size; both *r* and *ʒ* are deeply striated parallel to their intersection. The prism faces are not prominent, and are slightly striated parallel to the vertical axes. The crystal from which the figures were made measures approximately 8 mm. in greatest diameter; it is broken across in the direction of the edge *r x*. After preliminary 'one-circle' measurement in two zones, several faces were identified and the habit made out; the crystal was then mounted with the prism zone normal to the vertical circle, and the co-ordinate angles obtained. With the exception of *r* and *ʒ* which have both faces present, all the forms were determined from single planes; the faces *f* (011), *g* (021) and *y* $(1\bar{3}1)$ gave no distinct signal, and were measured in the position of brightest illumination. Owing to the difficulty of accurately centring, and the small size and imperfections of some of the faces, the measured and calculated angles do not always agree closely."

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* Subsequent examination has shown the principal mineral to be amphibole, generally actinolitic.

Geologically the occurrence of the axinite-bearing rock, limurite, is of considerable interest. It has not yet been demonstrated as to whether it is an intrusive or an altered contact phenomenon; in all probability it will eventually be shown that the latter is the more correct interpretation

34. AZURITE *(Blue Carbonate of Copper).*

This beautiful mineral is only known to occur in this island as thin scaly masses, and as extremely minute crystals.

Localities: Hampshire Hills, Gad's Hill, Dundas, Zeehan, Mainwaring Inlet, Mackintosh River, Penguin, Saxon's Creek, Cascades, Heazlewood, near Scamander River, and other places

35. BARYTES (*Sulphate of Barium*).

This mineral crystallises in the orthorhombic system; the crystals vary much in habit, often being prismatic by extension in the direction of one or other of the axes. Tabular crystals are common. Its common appellation is "heavy spar." Although barytes is such an abundant gangue mineral in the veinstone of the North of England and on the Continent of Europe, as well as occurring in wonderfully-developed crystals, as found in this island it is the very antithesis of the Old World occurrences, for it does not, so far as known, appear in our lead-bearing lodes; and it is of the utmost rarity in a crystal form, although the amorphous heavy spar is extremely abundant in certain localities. It is here usually found as a dense amorphous mass, quite opaque, or at least exceptionally in a translucent condition. In colour it varies from almost white to a pale yellowish-brown. Occurs with galena at the Linton P.A., North-East Dundas; at Howard's Plains, Mt. Lyell, in compact masses; at Surrey Hills, containing a little chalcopyrite and minerals resulting from the decomposition of same; in veins at the Minnow River, under Mt. Roland; at Rocky River, a tributary of the Pieman, with nickel ores; at the Wilmot River, with native copper; at the Specimen Reef Mine, Savage River, with pyrites and sometimes gold; Huskisson River, with pyrite and disseminated galena; near Deloraine, with calcite, siderite, and galena; on the banks of the Upper Leven River; Mackintosh River; at Mt. Read, near the Hercules Mine; between Mts. Darwin and Jukes; Alma Proprietary Association's property; near the confluence of the Forth and Wilmot Rivers; and in considerable quantity at the Two Hummocks, Surrey Hills, 15 miles from Hampshire and 8 miles from the Emu Bay Company's railway system. It also occurs as an outcrop in a flat 3 miles east from the Emu Bay Railway Company's line at its junction with the old Farrell tramway, and it forms an extensive outcrop south of the Murchison River, containing a little galena.

36. BARRANDITE (*Hydrous Phosphate of Aluminium and Iron*).

Occurs as dull amorphous indistinctly radiated masses, of small size, brown colour, with a greasy lustre. They were found associated with vivianite.

Locality: Lyndhurst, North-East Coast.

37. BASANITE (*A Variety of $Si\,O_2$*).

This is the lydian or touchstone, a compact black quartz. The stone was used for testing the quality of gold by rubbing that metal upon a smooth surface, the colour of the streak indicating the amount of impurity.

Localities: Swansea, Conara, and other places.

38. BASTITE. (See SCHILLER SPAR.)

39. BATCHELORITE (*Hydrated Silicate of Aluminium*).

This apparently new substance is, so far as known, always massive, without any indication of crystallisation. It has an indistinct cleavage, is imperfectly foliated, and slaty in general appearance. In feel it is remarkably smooth, and inclined to be unctuous. The colour is invariably a shade of green, from what may be termed a pale apple-green to greenish-grey. Lustre glimmering to shining, with an oily appearance on the smoother surfaces. It is translucent in thin flakes. Streak, white. Hardness = 4. Specific gravity = 3·3.

Analysis by G. F. Beardsley (as green nodules in schist):—

		Per cent.
$Si\,O_2$	=	49·4
$Al_2\,O_3$	=	45·1
$H_2\,O$	=	5·6
		101·1

Answering to the formula—

$$H_2O\ Al_2\,O_3,\ Q\ Si\,O_2$$

(J. W. Gregory, Aus. Inst. Min. En., 1905.)

This is the substance which has been known as pyrophyllite (Catalogue of the Minerals of Tasmania, 1896, page 72, No. 207). It has also been termed agalmatolite. It is generally known on the Mt. Lyell mining field as "green schist," and also perhaps more commonly as serpentine, or even as "greenstone." As it takes a fairly high polish it has been used, to a limited extent, as watch-chain pendants. Professor Gregory remarks (*loc. cit.*) "that it is not a bisilicate such as pyrophyllite." It has been named in memory of the late Mr. W. T. Batchelor, at one time mine manager of the Mt. Lyell Mine, to whom the writer is indebted for many interesting mineral specimens, including excellent examples of this substance in particular. It is said to occur on one of the walls of the enormous cupreous pyritic ore-body of the Mt. Lyell Mine, and is remarkable for usually containing an appreciable quantity of gold; so much so, that it is at times noticeable as fine granular patches of fair extent. It is reported to be occasionally extremely rich in the desirable metal.

Mr. R. Sticht informs me that at the North Lyell Mine a pale green amorphous substance occurs, which might outwardly be mistaken for this mineral. It is apparently a mixture rich in alkalies.

An analysis gave the following result:—

		Per cent.
$Si\,O_2$	=	46·6
$Al_2\,O_3$	=	39·7
$Na_2\,O$	=	5·52
$K_2\,O$	=	1·87
Combined $H^2\,O$	=	5·4
		99·09

Oxygen ratio, 24·85 : 20·44 or 1·21 : 1.

40. Bauxite *(Hydrated Oxides of Aluminium and Iron).*

The important ore of aluminium from which the metal is commercially obtained. It usually occurs earthy and clay-like, and is often discoloured by sesquioxide of iron. The substance apparently originates from the alteration of effusive igneous rocks rich in aluminium and low in silica. A substance from the vicinity of Port Davey agrees fairly well with the general characteristics of bauxite, although no complete analysis has been made.

41. Bellite *(Chromoarsenate of Lead).*

This extremely interesting, and it may be said attractive, new substance usually occurs in delicate tufts aggregated together, and velvet-like coated surfaces thickly lining and clustering in drusy cavities in somewhat soft iron-manganese gossan. The coated surfaces are often met with of reasonable size, and have been obtained covering several square inches of the gossan, more especially where vughs and fractures occur. More rarely bunches of galena are wholly or partially covered by the substance. It is often in crypto-crystalline incrustations, occasionally pulverulent, and more rarely in bunches of hexagonal crystals of almost microscopic dimensions. The largest crystals so far observed were but 3 millimetres in length, but the outline was sharp and very distinct. The crystals are of adamantine lustre, and remarkably bright red to crimson colour. Minute acicular patches of crystals are common, and under the lens are perfectly distinct, and thus afford very fine microscopic objects of considerable attractiveness. The bright crimson colour of the general mass is very characteristic, and by this feature it is noticeable by the most casual observer, even when not directly interested in mineralogy. It sometimes occurs in aggregates of extremely minute needles, much like velvet, of a distinct and bright yellow to orange colour, and in this form it also occasionally coats somewhat large surfaces. Chromiferous cerussite, and more rarely crocoisite and mimetite, are intimately associated with it. Although so noticeable, the coating of the substance is usually of such extreme thinness that it was only with the greatest difficulty and by using the utmost care that enough was secured to make a complete analysis. This was undertaken by Mr. J. D. Millen, A.S.T.C., M.S.C.I., Lond., General Manager of the Mt Bischoff Company. The following is the result:—

		Per cent.
PbO	=	61·680
CrO_3	=	22·611
V_2O_5	=	0·106
P_2O_5	=	0·045
As_2O_3	=	6·548
Al_2O_3	=	0·012
Cl	=	0·516
SO_3	=	0·054
Ag	=	trace
SiO_2	=	7·587
		99·156

Formula—

$$PbCrO_4 + As_2O_8$$

Moisture not determined. The hardness is 2·5; specific gravity, approximately 5·5. Streak, pale-yellow. Crystallographic system hexagonal. Before the blowpipe on coal it readily affords a bead of metallic lead, with arsenical coating and odour. Imparts to salt of phosphorus bead in OF and RF a fine green, thus absolutely masking the reaction V_2O_5 in the OF with this reagent. In the wet the reaction of V_2O_5 was only obtained with difficulty, following the method of Dr. Ohly ("Analysis of the Rare Metals"). The powdered substance was mixed with sodium carbonate, then fused, and after the addition of potassium nitrate lixiviated with water, filtered, and the clear solution boiled with ammonium carbonate. Acidified with hydrochloric acid, and hydrogen sulphide passed through the filtrate, the precipitate gave arsenic and green solution. The filtrate with concentrated ammonium of equal volume and treated with hydrogen sulphide gave a black precipitate which on filtering the solution left a cherry-red solution = vanadium. This new mineral species has been named in compliment to the writer's old respected friend, Mr. W. R. Bell, the veteran prospector, whose exertion has done much to advance the mining industry of this State, and who moreover has always taken a great interest in its mineralogy and geology.

Locality: The upper workings of the Magnet Silver Mine, Magnet.

42. BERESOWITE *(Chromate and Carbonate of Lead).*

An extremely rare mineral previously only recorded from Berezov, Siberia. At the Magnet Mine it occurs as small, in many cases almost microscopic, lamellæ implanted in gossan. In colour it varies from pale-yellow to orange-red. It is at times altered to crocoisite. It is confined to the cracks and vughs in the gossan, where it forms coatings of minute plates and pseudocrystals, which often nestle in little bunches. It not uncommonly decomposes to massicot, and is at all times difficult to preserve owing to its slight attachment to the base. Formula for this species, $6PbO\,3CrO_3\,CO_2$.

43. BERTHIERITE *(Sulphide of Antimony and Iron).*

Usually of a dark steel-grey colour, with a metallic lustre and irregularly striated surface. Found in considerable quantity, but low in silver contents.

Locality: Mt. Bischoff.

44 BERYL *(Silicate of Aluminium and Glucina).*

The true emerald has not so far been found here, but hexagonal prisms which are colourless to bluish-green have been obtained at Flinders Island; and also waterworn pebbles, in stanniferous drift, at Mt. Cameron. At the last locality a fairly good example was obtained some years ago. It consisted of portion of a crystal about an inch in diameter and the same in length; it had the true hexagonal form and characteristic cleavage, and the colour was dull-green with a translucent appearance. The stone was mistaken by the miners for a peculiar form of copper ore. More recently another specimen was obtained in the drift of almost the same colouration, rather less in diameter, but nearly 3 inches in length. Near the Great Republic Tin Mine at Ben Lomond this mineral has been discovered in exceptionally large and well-formed crystal groups. The find occurred in surface trenching across the granite rock, when a somewhat large quantity of the beryl was exposed, intimately associated with extremely large and fine crystals of orthoclase. Many of the individual crystals of the beryl measured fully 10 inches in length and nearly 2 inches in thickness. The colour is unusual, being a mottled yellow-brown, with a dull lustre on the exterior surface. Many of the groups were strangely united and semi-mackled, but all had the characteristic hexagonal form. An approximate analysis kindly made by Mr. W. F. Ward, Government Analyst, gave the following return, viz.:—

		Per cent.
Silica	=	66·0
Glucina (Beryllia)	=	8·0
Alumina	=	18·0
Oxide of iron	=	8·0
		100·0

Thin sections of this mineral from the lastmentioned locality, when examined under the high powers of the microscope, were found to contain numerous fluid enclosures (liquid carbonic acid), varying very much in size, but usually of an ovate form. They are commonly arranged in lines, with a slight curvature, and graduate in size from moderate dimensions to extremely minute. In these enclosures minute bubbles are very plentiful, and many have a spontaneous motion of variable intensity. At the Shepherd and Murphy Mine, Bell Mount, specimens have occurred several inches in length, wholly changed to gilbertite, fluor, and chlorite. At the same locality small slender crystals have been met with of a pale-green colour, intermixed with quartz, topaz, molybdenite, and cassiterite. The crystals are commonly embedded in a thin film of pyrite. In a tin-bearing vein traversing the granite on the St. Paul's River, opposite Brookstead, small bright-green specimens have been obtained closely intermixed with crystals of cassiterite.

45. BINDHEIMITE *(Hydrous Antimonate of Lead).*

Commonly known on the Western mining-field as "canary" and "picos" ore. It often occurs in somewhat large quantity, with carbonate and sulphate of lead, above the sulphide zone in the silver-lead mines. It is occasionally highly argentiferous. The following mines have afforded fine examples:—Comet, Adelaide Proprietary, Silver Queen, Godkin, and Whyte River.

46. BISMUTOSPHARITE (*Bismuth Carbonate*).

The anhydrous bismuth carbonate is of uncommon occurrence. It occurs in spherical forms aggregated together, with fibrous radiating structure. The colour is pale-yellow to grey. It is not known crystallised. Occurs sparingly at the Shepherd and Murphy Mine, Bell Mount.

47. BIOTITE (*Orthosilicate of Potassium, Magnesium, Aluminium, and Iron*).

This is the common black or dark-coloured mica which forms such an important essential in many rocks. It crystallises in the monoclinic system with a pseudo-rhombohedral habit, but often with an hexagonal outline, and is abundant as irregular imbedded flakes or scales. It may be transparent or opaque. Biotite is an abundant constituent in crystalline rocks, such as gneiss, and is often associated with muscovite. It is also common in eruptive rocks, such as granite, syenite, trachyte, andesite, and others. It also results from alteration in contact rocks, and may be secondary to many mineral species. It is abundant of a greenish colour at Mt. Heemskirk; of a frondose form at North Pieman; in somewhat large plates on the east central side of Flinders Island; and many other localities in its rock-forming character.

48. BISMITE (*Oxide of Bismuth*).

Of very rare occurrence. It is found as a thin yellowish earthy coating on other bismuth minerals at Mt. Ramsay; in arborescent crystal groups, occurring in the cleavage planes of country-rock, colour of a greenish-yellow, Hampshire Silver Mine (W. R. Bell); West Cumberland Tin Mine, Mt. Heemskirk; at the Curtin-Davis Mine, Dundas, where it is highly argentiferous.

49. BISMUTH, Native.

Abundantly distributed throughout a sub-crystalline black hornblende or amphibole of massive structure that occurs as an extensive lenticular formation at Mt. Ramsay. The metal is freely distributed in small irregular particles and flaky masses, varying in size from microscopic grains to pieces weighing several ounces. It occurs associated with blue and white fluor, scheelite, and axinite, with the metallic minerals pyrrhotite, chalcopyrite, and pyrite. The mass of hornblende occurs as a contact formation abutting upon granite on the one side and an igneous rock on the other. At Mt. Read this metal has been discovered in quartz with fluor; it has also been obtained at the Blue Tier in granite, with cassiterite and molybdenite. Some of the alluvial gold obtained at the Ring River is said to contain this metal as an alloy; it would therefore approach the substance that has been named maldonite. Although bismuth is commonly auriferous it is not so at Mt. Ramsay; the gold at that locality was obtained from chalcopyrite and mispickel. Obtained as small waterworn pieces Wilson's Creek, Pieman River; with cassiterite at Middlesex.

50. Bismuthinite *(Trisulphide of Bismuth).*

This is also known as bismuth glance. It crystallises in the orthorhombic system like stibnite, to which it is chemically allied, and which it resembles in its physical characters. It commonly affects a bladed habit; the crystals are prismatic, but usually acicular. These needle-like forms are of a lead-gray colour with metallic lustre, and brittle. Their surface is often tarnished. The mineral has a perfect cleavage parallel to the blades; the surfaces thus formed are smooth and highly polished. In somewhat rare instances the mineral assumes a capillary form, the filaments being not infrequently interwoven with the gangue minerals. Bismuthinite is in all probability an original mineral, but it is easily affected, and commonly changes to the carbonate, oxide, or other secondary forms. It is a frequent accessory in tin lodes, and often accompanies wolframite, molybdenite, and fluorite. The frequent presence of the last-named suggests that fluorine may have been an active agency in the deposition of such minerals as those mentioned. It occurs in small irregular patches with the native metal in the amphibolite of Mt. Ramsay. It has been met with in the workings of the Federal Tin Mine at Heemskirk, and in other mines in the vicinity, and at the Blue Tier in the stanniferous granite in small quantity. At the East Hercules it has been met with in chlorite schist with pyrite and a little fluorite. At the South Curtin-Davis Mine, Dundas, and others adjacent, it has been mined in some quantity, intimately associated with tetrahedrite and pyrite. The bismuth sulphide occurs as spiculated blades more or less compact, which are very irregularly disseminated throughout the minerals referred to. At the Mt. Black Mine, situated near Rosebery, it has been detached in limited quantity closely associated with chalcopyrite, pyrite, and fluorite, both purple and greenish, with a small but appreciable amount of amorphous wolframite and intensely black finely radiating tourmaline. The most important occurrence of bismuthinite known to exist in the island is that of the Shepherd and Murphy Tin-Wolfram-Bismuth Mine at Bell Mount, Middlesex. The mineral appears in what seems to be a series of small lodes, which are much faulted, but regular in the direction of throw, and with a general strike east and west. They occur at or near the contact of quartzite and a metamorphic yellow garnet rock, the latter constantly without crystallisation, and comparatively soft near its junction with the former, but hardening gradually and imperceptibly at a distance from the lodes, being finally in part capped with black vesicular basalt of the Tertiary type. The harder garnet rock contains much magnetite and a salmon-coloured mineral. The series of small lodes occurs in both the quartzite and garnet rocks, and all have a general quartz gangue, which is often crystallised in and about the numerous small vughs which are commonly met with in practical mining operations; some topaz is always present in small crystals, and a prosopite-like mineral is not uncommon, but usually altered to achlusite. Fluorite of various colours is plentiful, but not in the crystallised form; the main colours are purple and green, as is usually the case. The bismuthinite is much altered to the carbonate of the metal in the upper workings, and is accompanied by pyrite, and the associates are wolframite, at times in small crystals or crystalline masses, and intensely black cassiterite in small crystals and groups. Many of the latter are geniculate, and, with the other metallic minerals, are often imbedded in a white lithomargic substance. Molybdenite in small but fairly well-developed crystals is occasionally met with. The blades of bismuthinite are often attached to quartz crystals in the interstices of the gangue, and they are not uncommonly, as fine needles, found embedded in the white lithomargic material and crevices of fluorite. Terminated crystals of bismuthinite are unknown. The acicular crystals sometimes occur grouped in the cavernous quartz gangue, or they may be in capillary patches, in which case there is usually pyrophyllite in close association.

51. Bismutite *(Hydrous Carbonate of Bismuth).*

This mineral is only known in the pulverulent and amorphous condition, resulting from the alteration of the sulphide of the metal. It has been detected in small coatings and blebs at Mt. Ramsay, North-East Dundas, and at the Hampshire. At the Federal Mine, Heemskirk, it has occurred intimately intermixed with quartz and tourmaline. The Shepherd and Murphy Mine, Middlesex, has afforded by far the largest quantity hitherto found in this State. It occurs as an accessory in a series of small lodes in close association with, and at times containing a nucleus of bismuthinite, wolframite, and cassiterite in a matrix of quartz, with which topaz is intermixed, wollastonite, and occasionally fluorite.

52. Blende. (See Sphalerite.)

53. Bornite *(Sulphide of Copper and Iron).*

This mineral is also known under the name of erubescite, but that given appears to have priority; it is also known under the vernacular term of "purple ore" or "horseflesh ore." Empirically its copper contents are 55 per cent., much more than chalcopyrite, but less than covellite (the blue sulphide) and chalcocite (the black or gray sulphide). In crystallisation it is cubic, the crystals being often confusedly aggregated together and commonly very irregular. Although this species is notably profuse in this State the crystallised specimens are of extreme rarity, and only occur very sparingly. When freshly fractured the mineral presents a bronzy surface, which rapidly suffers tarnish on exposure; it is often iridescent. It usually occurs in the superficial workings of the mines, but has been known to extend to considerable depths. It is probable that it originates from the alteration of chalcopyrite by the action of circulating waters containing copper sulphates. The most notable occurrence in this island is in the Mt. Lyell district, where it occurs as a replacement of the schists of the locality; it is here a most important ore of copper, and is extensively mined. At this locality it is usually argentiferous and auriferous, the silver contents occasionally being remarkably high. It also occurs at Mainwaring Inlet in quartz, the Heazlewood district, and to a limited extent at other localities.

At the 600-feet level of the North Lyell Mine a mixture of bornite and chalcocite occurs, which upon analysis gave the following return:

		Per cent.
Copper	=	59·6
Sulphur	=	22·0
Iron	=	9·0
Silica	=	5·8
Alumina	=	3·4

		Ozs. per ton.
Silver	=	13·0
Gold	=	0·01

Discarding the 9·2 per cent. of foreign matter, it appears that the aggregate consisted of 60 per cent. of bornite (Cu_3 Fe S) and 40 per cent. of chalcocite (Cu_2 S). (R. Sticht.)

54. BOULANGERITE *(Sulphantimonite of Lead).*

Occurs near Waratah with siderite and marmatite in a lode, the gangue of which is fluorspar and quartz. The samples vary in structure to some extent; they are commonly fibrous and compact, but may graduate to a form which often has a granular structure. The lustre is invariably silky and metallic. At Dundas it occurs both fibrous and massive, and is often associated with jamesonite, pyrites, cerussite, and massicot. At Block 291 it occurs with arsenopyrite in a matrix of siderite.

55. BOURNONITE *(Sulphantimonite of Lead and Copper).*

Occurs in patches near the junction of the slates and granite on the south-east shores of King Island (Gould, Pro. Roy. Soc. Tas., (1871). At Zeehan this mineral occurs both in the massive state and as well-formed crystals intermixed with quartz and galena. On a tribute of the Argent Company some remarkably fine crystal groups have been obtained, associated with siderite and another compound sulphide. The bright well-developed orthorhombic crystals gave the following result upon analysis:

		Per cent.
S	=	13·62
Sb	=	28·68
Pb	=	42·39
Cu	=	11·93
Fe	=	1·97
		98·40

56. **Braunite** *(Silicomanganate of Manganese).*

A dark brownish-black to steel-grey mineral, with the streak the same colour. Hardness, 6·65. Specific gravity, 4·75. Occurs abundantly at the West Comet Mine, Dundas.

57. **Bronzite.** (See **Enstatite.**)

58. **Breithauptite** *(Antimonite of Nickel).*

This substance has a distinctly copper-red colouration and crystallises in the hexagonal system.

Analysis by Mr. W. F. Ward:—

		Per cent.
Ni	=	34
As	=	23
Sb	=	37

It does not appear to be plentiful.

Locality: Central Balstrup Section, Zeehan.

59. **Brookite** *(Titanic Oxide).*

This species is of the same composition as the more abundant rutile, but crystallises in the orthorhombic system. It occurs with it and anatase at Clayton's Rivulet, also near the Pieman River and at Back Creek, near Lefroy. At the last locality it is found in flaky pieces, which are blood-red in colour by transmitted light.

60. **Brucite** *(Hydrated Magnesium Oxide).*

The common form of this mineral is massive and foliated with a somewhat pearly lustre. It is invariably found in or near serpentine. Occurs in large masses at the Heazlewood; in hexagonal plates which are embedded in serpentine, Lower Castray River; common, west of

Beaconsfield; Mt. Heemskirk, foliated and partly altered to hydromagnesite (Ballarat School of Mines Museum). As crystalline bunches at Trial Harbour, West Coast.

61. CALAMINE *(Carbonate of Zinc).*

Although a rare mineral as occurring on the large scale, small quantities have been found at several of the Zeehan and Heazlewood silver-lead mines.

62. CAMPYLITE *(Chloroarsenate of Lead).*

Small patches of the characteristic barrel-shaped crystals of this variety of mimetite have occurred at the old Britannia Mine, Zeehan, and near Williamsford, Mt. Read.

63. CARMINITE *(Arsenate of Lead and Iron).*

An extremely rare mineral, which occurs in minute orthorhombic groups of crystals that usually gather together in the fractures, and lining the vughs in gossan. The crystals are of a distinct reddish colour with a strong adamantine lustre. It occurs, in limited quantity, at the Magnet Mine.

64. CALCITE *(Carbonate of Calcium).*

This well-known mineral crystallises in the rhombohedral system. The varieties of crystalline form assumed by calcite exceed those of all other minerals, and have been carefully studied by mineralogists; so much so, that above two hundred forms have been recorded. With the exception of quartz, it is the most profuse of all minerals, occurring in the form of marble and limestone in enormous quantities. The beautiful Old World crystallisations of this mineral, such as occur in Derbyshire and the North of England, are unknown in this island, although in the massive form it occurs abundantly, the notable localities being Bridgewater, Maria Island, Gordon River, Beaconsfield, Don River, Mackintosh River, and other places. As travertine, containing numerous fossil land-shells, it occurs at Geilston on the east bank of the Derwent; as Iceland spar, it is plentiful near St. Marys; as stalactites it is in profusion at the caves of Chudleigh, near Frankford, and at the Upper Forth River; as small blue-coloured crystals, at the Madame Melba Mine, North Dundas; and some remarkably fine crystals have been obtained at the limestone flux quarry of the Mt. Lyell

Company, near Queenstown. It sometimes occurs in the veinstone of metallic lodes, but is not known in large quantity in this connection.

65. CASSITERITE *(Dioxide of Tin).*

As is well known, this is the common ore of tin, which is practically the only commercial one of the metal. It has a wide geographical distribution, but in few localities does this ore occur in such quantity as to be of economic importance. It has been fully established that in all parts of the world there exists a striking connection between the occurrence of tin ore and the intrusion of an acid plutonic magma, resulting in the formation of granite and kindred rockmasses. It has further been proved that such occurrences are closely associated with a peculiar group of minerals characterised by the presence of fluorine, boron, phosphorus, and arsenic. This connection is so pronounced, that it was early in the last century that Daubrée formulated the now almost universally-accepted theory that the tin was brought up from plutonic depths in the form of a volatile fluoride. The emanations were probably at a temperature above critical point, or in the permanently gaseous state, in which condition they would be the means of producing an alteration in the rocks which has been termed pneumatolytic. It is believed by Vogt, who has carefully studied the genesis of ore-deposits, that the formation of tin-lodes probably started before the absolute cooling of the granite. It is also supposed that many tin-bearing deposits have been favourably effected by the agency of permeating thermal waters. It has been shown that cassiterite is sparingly soluble in water containing alkaline carbonates, and even slightly in distilled water at 80° C., which solubility is much increased by the presence of sodium fluoride. It has been found that a deposit of opaline silica formed from a warm spring at Selangor contained on analysis 0·5 per cent. of stannic oxide. There are records which show that in Cornwall antlers of the red deer have been found in the tin-bearing gravels partially transmuted to, or impregnated with cassiterite. In the same way beautifully developed crystals, mostly Carlsbad twins, of orthoclase have been altered or pseudomorphed to the same substance at the Wheal Cootes and other mines in the same Old World tin-mining locality. In this island much the same thing has occurred, although to a somewhat less pronounced extent, in the tin-bearing granite of Mt. Rex, where the outline of the felspar crystals can be distinctly traced, the whole being converted to tin ore, and the shape of the crystal being faithfully preserved. At the Stanley River the imbedded felspars have also been converted to cassiterite and green tourmaline, and at Mt. Bischoff the same thing has occurred with respect to the felspars originally contained in the topaz porphyry so characteristic of the locality. The replacement at this spot is not always complete, inasmuch as the interior of the felspar outline may be but partially filled with the black crystals of cassiterite, but the whole stands out prominently on the white groundmass. At Cope's Creek, New South Wales, masses of fossilised wood have been obtained in the older drifts which are overlaid by basalt, partially converted to tin ore. At North-East Dundas breccias, consisting of fragmentary rock, probably broken from the walls of a lode or fault, have been obtained, absolutely cemented together with cassiterite, which has doubtless been deposited from circulating waters. The same phenomenon has been recorded as occurring at several localities in Cornwall, England. "It is contended by the chemist Bischoff that ordinary carbonated waters coursing through tin-bearing rock might be competent to dissolve felspar and to deposit tinstone in its place" (Rudler, "Minerals of the British Islands," 1905). The same remark probably applies to the other transmutations referred to.

Referring generally to tin-bearing veins or lodes, the formation or origin of these is the result of such a complex process that there is room for several explanations as to the different phases of cause and development. At Mt. Bischoff, which geologically stands out conspicuous as being almost unique, the cassiterite occurs disseminated in comparatively small crystals as well as in the massive form in a huge elvan course or dyke composed of quartz and topaz-porphyry (topazised quartz porphyry), which doubtless extends upwards from a deep-seated mass of granite, into the surrounding contorted and disturbed Cambro-Ordovician slates, or "killas," as the rock would be termed in Cornwall. It has attendant lodes of various sizes and strike, one at least of which intersects the main, or, as it is termed, the "Queen" dyke. These attendant lodes are in the main composed of quartz-porphyry, and so far as known only one shows any conspicuous departure in composition. The gangue of this is apparently a greisen unusually rich in white mica, much of which, so far as exploited, is decomposed and stained by iron oxide. Other dykes of quartz-porphyry occur in the neighbourhood of the main seat of mining operations, but that known as the Queen dyke is by far the most important from a mining standpoint. The topazisation of this has proceeded to the fullest extent, and in places remarkable impregnations of radiating acicular pycnite abound, while enormous masses of a peculiar green tourmaline are strikingly plentiful, as well as various pyrites and (in a minor degree) fluorite, siderite and prosopite, while wolframite is an extreme rarity. From a mineralogical standpoint this remarkable tin mine shows a relationship to the Schneckenstein of Saxony, inasmuch as several of the usually rarer minerals are common to both localities. At both places there are the advanced topazisation of the porphyry, the abundance of the cylindrical form of that mineral known as pycnite, and the occurrence of prosopite, the last being almost peculiar to the two localities mentioned. The cassiterite of Mt. Bischoff is not noted for its fine development, as it mainly occurs in remarkably small crystals, and much of it is in the form of actual slime in friable topaz. Cassiterite crystallises in the tetragonal system, and forms one of a group which includes the dioxides of tin, manganese, titanium and lead. They all belong to the same system of crystallisation, with closely similar angles and axial ratio. Cassiterite crystals are very commonly mackled, and not rarely show geniculate or knee-shaped forms. Zonal structure is often seen in microscopic sections of the crystals. This is well illustrated by the beautiful slides produced by sections of the pycnite of Mt. Bischoff, containing, as it usually does, associated tin crystals. The late Professor Ulrich states *in literis*:—"The crystals of this mineral (cassiterite) occurring at the Mt. Bischoff Tin Mine are in the average small, rarely exceeding 5 mm. in size. They are generally also not well developed, having rounded edges and often broken faces. Their form is very simple; generally the unit pyramid and unit prism, with rounded-off edges, indicating an octagonal prism. Twinning according to the common law-twinning and composition plane, the diametral pyramid is very frequent." The East Coast tin-mining area affords masses in places of more or less altered granite, containing an appreciable quantity of cassiterite. Much of this rock is converted into greisen—a quartz-mica rock commonly associated with topaz and tourmaline. The ore-bearing veins appear in most cases to be altered rock, impregnated with cassiterite and the minerals usually occurring with it. It is from this district that many remarkably well-developed tin crystals are obtained. They are frequently found studding the walls of fissures and vughs in the lodestone. The veins and impregnations are often extremely irregular, varying in width and length, and even in extension to depth. In the Ben Lomond district pipes and floors have occurred with the tin ore occasionally in fair proportion. The Great Republic Mine is a fair example of the first, containing remarkably fine well-formed crystals of cassiterite with the companion minerals fluorite and pyrites. The floors are very similar to like occurrences in Cornwall, viz., a narrow crack, now often filled with chalcedony. That apparently served as a channel for the ascending vapours, which probably acting on the adjacent rock in favourable positions deposited the tin ore, which now appears as floors of limited extent, but often extremely high in tin contents.

The other tin-mining districts are those of Heemskirk, North-East Dundas, Cox's Bight in the extreme south, Mt. Ramsay, Bell Mount, and a few outlying localities.

The general characteristics of cassiterite as occurring in this island may be thus summarised:—In colour this mineral varies to a remarkable degree; it is commonly black and in various shades of brown, but is sometimes almost colourless, red, yellow (pale and dark), white, grey, and not rarely variegated. In structure it may be compact, fibrous, nodular, radiating, or crystalline. According to colour or structure its varied forms are termed by the miners black tin, ruby, resin, wood, shot-holed, mahogany, and other local appellations. Alluvial tin is generally much waterworn or rolled, but in many cases the crystals are but little abraded; it is usually opaque, but is occasionally translucent to almost clear transparent. Examples of this latter variety, when cut into gemstones, display a brilliancy second only, in their high refractive index, to the diamond. The adamantine lustre of fresh crystals, coloured or black, is very pronounced, and the eye is attracted by the splendent faces. As a rule stream or alluvial tin as with gold is commonly richer than that derived from its matrix or lodes. This is probably caused by the outer crust being abraded, the richer central portion remaining uncontaminated by any incrustation of foreign matter.

At North-East Dundas cassiterite is reported to occur under exceptional conditions in association and intermixed with solid compact magnetite. A parallel discovery was made at Carn Chuinneag, in Ross-shire, Scotland ("Summary of Progress" for 1903, p. 58); and at the Renison Bell Mine it occurs in a dense pyrrhotite, which is also extremely unusual for this mineral. Occurs of unusual habit at Mayne's Mine, Heemskirk. The colour varies from a pale dull-gray to almost black, and is commonly of a radiated fibrous structure, in botryoidal and reniform shapes. Where concentric structure is well-defined, the internal colouration is in bands of regular width of various shades of gray to brown. In all essential characteristics this occurrence exactly corresponds with what is known as "wood tin" in Cornwall. An acute pyramidal intensely black variety, representing what has been termed sparable or "needle" tin in the European mining districts, occurs at Welsh's tin find near the five-mile on the Waratah-Corinna-road. The crystals are minute, very pointed, and a good imitation of the Old World form. At Mt. Agnew the alluvial tin is contaminated by plentiful grains of chromite, while near the Huskisson, to the north-west of the Renison Bell Mine, the tin ore is intermixed with osmiridium, derived doubtless from the adjacent serpentine rock. At the Stanley River, South Esk, Pioneer, and many other alluvial mines monazite is of common occurrence in the form of minute yellowish particles. At the Shepherd and Murphy Mine, Bell Mount, it occurs in a series of small lodes, closely associated with wolframite, bismuthinite, achlusite and fluorite. At this mine groups of geniculated crystals are somewhat common, often approaching the rutile law.

"The radiating fibrous variety, with concentric differently-coloured zones—called toad's-eye tin—occurs in the alluvial deposits occupying the western slopes of Mt. Heemskirk in the vicinity of the Federation Mine. . . . Cassiterite has recently been found on the Oonah lease in Zeehan. It occurs with quartz and pyrite, forming a fine-grained granular aggregate cemented by quartz in the oxidised portion of the lode. . . . . Analyses of the stannite of the Oonah Mine have disclosed a certain content of tin in the form of oxide. The proportion occurring in the stannite is variable, and may represent as much as 15 per cent. of the total tin contents. This oxide is, in all probability, finely-divided cassiterite.

In all localities quartz and cassiterite are always closely intermixed; and at times remarkably well-developed crystals of the latter are found implanted on the first, or even enclosed as endomorphs. A peculiar fibrous cassiterite of a deep brown colour, which is apparently pseudomorphous after tourmaline, occurs on the Boulder mineral section, North-East Dundas. It is closely intermixed with arsenopyrite. It occurred in a prospecting shaft." (L. K. Ward.)

This island is one of the most important tin-producing countries of the world, and a peculiar interest is attached to its discovery, as it was apparently one of the first minerals found in Australasia of which we have any record. Professor Liversidge states ("Minerals of New South Wales," p. 77):—"The probable presence of tin in Australia was mentioned as early as January, 1799. Collins, in his account of the English colony of New South Wales, states that Mr. Bass, the surgeon of H.M.S. 'Reliance,' found on the beach of Preservation Island (on the north coast of Tasmania, near the south coast of Barren Island) a very considerable quantity of the black metallic particles which appear in the granite as black shining specks, and are in all probability grains of tin." The next record which the writer has met with occurs in the proceedings of the Royal Society of Tasmania for the year 1854, pp. 425-431, in which reference is made to samples in the museum of a Mr. Thomas Winsmore Wilson, of Barnsley, Yorkshire, England. In this paper the following remarks occur:—"No. 25, tinstone—as regards this tinstone I need not remind you of its value. If you could open a mine as rich in tin as this specimen you would be very fortunate in the mining department." This sample was obtained "on elevated land below the Tier, St. Paul's Plains." The wonderfully rich deposit of tin at Mt. Bischoff was discovered by Mr. James Smith in 1871, and soon after that year many other payable finds occurred, principally in the north-eastern portion of the island.

66. CERARGYRITE *(Chloride of Silver).*

The well-known silver chloride has been obtained in limited quantity at the Dundas, Zeehan, Heazlewood, and Scamander silver-fields. As found here it occurs as minute irregular blebs and patches, rarely crystallised, in ferro-manganese gossan, siliceous lode material, and lithomargic clay. It is commonly associated with other oxidised metallic minerals. At the Warrentinna goldfield it occasionally occurs in the cavities of auriferous quartz in the upper working of the mines.

67. CERUSSITE *(Carbonate of Lead)*.

The native lead carbonate is almost an invariable accompaniment, in more or less quantity and perfection, of the sulphide in lead mines. It is subject to ready formation by the action of carbonic acid derived from a gangue or adjacent rock containing soluble calcium carbonate such as ordinary calcite, dolomite or ankerite, and is thus a secondary mineral, where its formation is due to epigenic action mainly in the upper or more superficial portions of the lode. It crystallises in the orthorhombic system, and but few mineral species afford such extreme variation of crystal habit or diversity of arrangement of the individual groups or bunches. It is at times in the form of a white amorphous mass, or thin coating on its parent galena, or a thin layer of sulphate may rest between the original sulphide and the external carbonate. Within the zone of oxidation it is frequently in enormous quantity, and cavities in the surface outcrop or galena may contain fairly developed crystals; these are often met with in exquisite perfection. When attached to a gossany base it attests the superficial origin of the group. It is frequently in the form of long slender crystals, often acicular and of extreme delicacy. They may be almost water-clear or snow-white, in which latter case when implanted, as is not rarely the case, on almost black ferromanganese gossan, they afford specimens of remarkable refinement. Again, the arrangement of the long acicular crystals may be in a crudely stellate pattern of equal attractiveness. Such masses occur in both these states at the Comet Mine, Dundas. The large vughs which have occasionally been met with at the Hercules Mine, Mt. Read, have been found on many occasions completely lined with a comparatively thick coating of exquisitely beautiful crystals of this mineral, oftentimes much stained externally with cupric carbonate and iron oxide, the pure white of the cerussite strongly contrasting with the green and blue of the copper and yellow of the iron. At the Magnet Mine many perfectly-formed groups of crystals have been frequently obtained. They are often seated on the parent mineral galena or nestling in the cavities. In the gossan zone they are very frequent and of perfect form, showing single crystals as well as mackles and trillings. In certain positions they are of a bright yellow colour, owing to chromic acid influence, but the clear to glassy condition prevails. Fairly large quantities have been mined at the Silver Queen, Sylvester, Austral, and other mines at Zeehan, and the Heazlewood mines have one and all produced excellent examples, amorphous, sub-crystalline, and of perfect crystallisation. It is always an attractive mineral, and one such as soon arrests the attention of visitors to the silver-lead localities, and thus the most elementary collections are almost certain to contain specimens. It frequently assays, in common with the sulphate, high in silver, as is the case to a notable extent at the Heazlewood and Magnet Mines. At the Heazlewood and Whyte River Silver-lead Mines, and to a lesser degree at the Magnet Mine, small almost amorphous masses of a peculiar gray lead carbonate have been found to be remarkably rich in silver, so much so that assays have been made giving returns equal to considerably over 1000 oz. of that metal per ton of lead. This result tends to show that the hypothetical silver carbonate (selbite) may have actual existence, and was answerable for the gray, colouration, but tests generally, though not invariably, result in proving an admixture of a haloid of the metal. The selbite has never been isolated, so that its occurrence in nature remains unsolved.

Dr. C. Anderson has studied the Tasmanian crystals of cerussite and states (Records of the Australian Museum, Vol. VI., Part 5, 1907), referring to a specimen from Zeehan, "One specimen in the museum collection shows several small but well-developed crystals, simple and twinned, on a matrix of galena with patches of friable limonite. A doublet on *m* was measured and yielded the forms *c* (001) *b* (010) *m* (110) *r*. (130), *x* (012), *k* (011) *i* (021) *v* (031) z (041) *p* (111). The faces in the zone (010, 001) are striated and slightly interoscillating. A group is made up of four individuals, of which I. and II., also III. and IV., are twinned to each other on *m*, while I. is twinned to III. and II. to IV. on a possible face (760) for which the colouration value of *φ* is 62° 24′. This form has not been recorded for cerussite, and it is just possible that we have here merely a case of accidental grouping; but the measured angles given agree rather well with the assumption that a new twinning law is in operation."

Respecting cerussite from the Washington Extended Mine, Whyte River, Dr. Anderson writes:—"This is represented in our collection by one specimen, in which small crystals of cerussite occur in cavities in galena coated with yellow limonite; in habit it is tabular on *b*, which is slightly striated to prism and brachy-dome intersections."

Referring to the same mineral from the Comet Mine, Dundas, "The crystals which occur on a *matrix* of galena and powdery limonite are thin tabular on *b* and twinned on *m*; the figured crystal is a trilling resembling the cerussite of the Magnet Mine. The two crystals twinned to that in the conventional position are small in comparison, and scarcely penetrate the larger." "At the Magnet Mine, Tasmania, cerussite occurs in two different habits, long prismatic or tabular on the *b* (010) pinacoid, and as flat tables parallel to the basal plane. In both cases the crystals are twinned on the faces *m* (110) and *m* 111, (110) resulting in trillings of pseudo-hexagonal form. A specimen in the museum collection furnished crystals of the first habit, while Mr. W. F. Petterd obligingly lent some examples of the other. An interesting feature is that the flat pseudo-hexagonal tables of the second habit are invariably contaminated with chromate of lead, doubtless in the form of crocoisite, which imparts to them a canary-yellow colour with occasional patches of red. The two crystals measured were essentially similar, being elongated along the vertical axis and tabular on the *b* (010) pinacoid. The same forms are present in both, namely *c* (001), *a* (100), *b* (010), *m* (110), *r* (130), *i* (021), *x* (102), and *p* (111). In the figure the breadth along the *a* axis is somewhat exaggerated, and the three individuals are drawn in equi-poise, though really only one is well-formed, the other two being quite subordinate. All the forms except *b* are relatively narrow, and the prism zone is much striated and interrupted. Of the three individuals forming the trillings, I. is placed in the conventional position, while II. and III. are twinned on the faces (110) and (110) respectively of I. Thus the faces *m* and *p* are coplanar with *m* and *p*, while *m* and *p* are coplanar with m^1 and p^1, and similarly at the other end of the *a* axis of I., but II. and III. have only one coplanar face, namely the base *c*. The figure is similar to the well-known drawing by Schrauf, but the Magnet mineral has three more forms. The table of angles below gives the measured and calculated values for I., and also the observed angles belonging to forms on II. and III., as owing to the small size and imperfect development of the crystals, on the goniometer it was impossible to distinguish the reflections belonging to the several individuals, and it was mainly from the angular measurements that the twinning structure was deduced. Habit II.—The crystals with this habit differ from the others mainly in having a large basal plane, and in being greatly shortened along the vertical axis, the result being flat tables approaching the hexagonal forms. That they are trillings is at once apparent from the re-entrant angles on the edges, and the three systems of striations on the basal plane, which are well seen under the microscope, crossing at angles of approximately 60° and running parallel to the brachy-axis of each individual. Crystals of a similar habit have already been observed in aragonite, but prismatic crystals seem more common with cerussite. One lot of isolated crystals of a pronounced yellowish colour average 6 mm. in diameter. A few smaller crystals measuring about 1 mm. in diameter, translucent, and of a much paler colour, were found implanted on the matrix. These latter supplied the best measurements on the goniometer. The most prominent face after the basal plane is the pyramid *o* (112); only one doubtful angle could be referred to the prism *r*, which is accordingly not entered in the figure. The forms recognised are *c* (001), *a* (100), *b* (010) *m* (110), *i* (021), *k* (011) *p* (111) *o* (112). The drawing suggests Laspeyre's figure of aragonite from Oberstein; only our crystal has more forms, and is drawn in ideal symmetry. The measured agree well with the theoretical angles."

Analysis of the characteristic form of a yellowish-green colour from the Adelaide Proprietary Mine, Dundas, by Mr. J. C. H. Mingaye, F.C.S., of Sydney, N.S.W.:—

PbO = 83·07 per cent.
CO_2 = 15·97 „
Cr_2O_3 = minute trace
Gangue = ·62 per cent.

99·66

Variety CHROMIFEROUS CERUSSITE (*Lead Carbonate with Chromic Acid*).

This attractive variety of a common species is, so far as known, confined to the Magnet Mine, in the upper workings of which it is, although local, fairly abundant. It occurs in fractures and vughs in the gossan zone, in bunches and sparsely attached as beautiful little crystals, generally in close association with crocoisite, but never, so far as observation has gone, intermixed with the normal form; although this is somewhat abundant in its usual adamantine characteristic habit, often showing remarkably perfect development in stellar and cruciform triplet crystals.

It is noticeable that, while the variety under review is invariably associated with the chromate of lead, the common type is rarely if ever obtained in the vicinity. It is always opaque, with a shining lustre, but not adamantine. The colour is canary-yellow, with an occasional tinge of red where the crystal has impinged upon the chromate. The tint does not vary to any serious extent, although paler examples are occasionally met with. It is a most attractive mineral, and soon arrests attention. Its most constant feature is its crystallisation in flattish frondose and spear-headed groups, twinned by repeated angles across different faces of the prism (110). The striated faces of the twinned groups are the brachyprisms O11 and O13; these are commonly deeply grooved, affording a most interesting leaf-life and unfamiliar appearance.

This variety is perfectly distinct, both as regards colour and habit of crystallisation. Moreover, intermediate variations between it and the normal type have not been met with. It is undoubtedly one of our most attractive and typical minerals. Under the blowpipe it gives reactions for chromic acid.

68. Cervantite (*Dioxide of Antimony*).

Abundant as a result of the decomposition of antimonial minerals, usually as a thin yellow coating on jamesonite, galena, and on veinstone. It is usually massive. Madame Melba, Comet, and Maestrie's Broken Hill Mines at Dundas are prominent localities. It also occurs in small quantity at several of the silver-lead mines in the Heazlewood district and at Zeehan. It has occurred in small quantity in a quartz reef known as Ragged Jack, about 9 miles east of Deddington, with pyrites, galena, and stibnite.

69. Chabazite (*Silicate of Aluminium, Sodium, and Calcium*).

This abundant zeolite occurs in the cavities of vesicular basalts. The obtuse rhombohedral crystals are usually well-formed, clear, and colourless. Abundant near the railway bridge which crosses the Hellyer River. Of small size, but well-formed groupings, Springfield; associated with other zeolitic minerals, olivine and calcite, Sheffield and near Mt. Claude; with ferro-calcite, Lefroy; occurs abundantly with vesicular basalt at Mt. Pelion and vicinity; the crystals are well-developed and in fine groupings, often lining the cavities. Rounded, waterworn nodules of the black basalt, which clearly show the implanted crystal groups, are often met with in the streams, and are sometimes mixed with other species of zeolitic minerals and ferro-calcite.

The crystals from Bell Mount, Middlesex, have been examined by Dr. C. Anderson, who states ("Records of the Australian Museum," Vol. VI., Part 5, 1907):—"Some fine crystals, ·75 to 1·5 cm. in diameter, have been found loose and coating a vugh in Tertiary basalt at this locality. Like the Ben Lomond and Inverell minerals, these are penetration twins on the vertical axis, but they differ from the former in the presence of *a* (1120) and *t* (1123)."

70. CHALCOCITE *(Sulphide of Copper).*

This, notwithstanding the large quantity of copper produced by the State, is an extremely rare mineral, and has only occurred at two or three localities. It crystallises in the orthorhombic system with an empirical composition of sulphur 20 per cent., and copper 80 per cent. = 100. It is the native cupreous sulphide, and is also known as copper glance, redruthite, and vitreous copper ore. It usually occurs in the upper workings of the mines, and is regarded as of secondary origin, produced by the alteration of chalcopyrite or yellow ore. It is commonly of a dark lead-gray colour, and is quite sectile and fusible—so soft as to be easily cut with a knife, and so fusible as to melt at a low heat. It is often reported to occur, but the genuine native cupreous sulphide is, as a matter of fact, but rarely obtained. In all probability the only true occurrences were in the Mt. Lyell district, and then but in extremely limited quantity. Crystalline masses of small size have been obtained at the Lyell Blocks, among other mines of the locality. Occurred at the King Jukes Mine, Mt. Jukes. Small crystals have been found disseminated on schist with bornite at the North Lyell Mine. It has been obtained in blocks of many pounds weight with native copper at the King Lyell Mine. Reported to occur with quartz at Mt. Balfour.

71. CHALCOPYRITE *(Sulphide of Copper and Iron).*

This mineral crystallises in the tetragonal system. The crystals are not by any means abundant; they affect a sphoroidal habit and are very often distorted, with the faces curved and striated. It is the common ore of copper in almost all copper-producing countries. It is an almost constant companion of cassiterite, although the bane of the tin-miner. The mineral is of a rich golden yellow, but easily tarnishes on exposure, when it may become iridescent, and is then known as "peacock ore." In practical mining it is often closely mixed with common iron pyrite, in which case the mixture has a paler colour. The two species may be easily distinguished by their respective colouration and hardness. Chalcopyrite is comparatively soft, easily yielding to the point of a knife, whilst the iron pyrites is not only much paler, but resists being scratched. The paragenetic relations of chalcopyrite are well understood, as it is so often associated with quartz, siderite, as well as with cassiterite. The recent formation of this mineral is shown by the action of thermal waters on objects containing copper. At several springs in Central France, chalcopyrite has been found on old Roman bronze coins. The sulphur in such cases is supplied by the sulphates in the waters, which are reduced to sulphides by the decomposition of organic matter (Rudler). Copper, probably this ore, was known to occur in this island as far back as 1822 (Evans' Description of Van Diemen's Land). It occurs, amongst many other localities, at Mt. Maurice; Badger Head; Saxon's Creek, in solid white quartz; Mainwaring Inlet; Cascade River, with cassiterite and schist; auriferous at Mt. Ramsay, with native bismuth in amphibolite; Dial Range; Lake Dora, as an impregnation in schist; Mt. Heemskirk; Scamander River, with galena and arsenopyrite; Blue Tier, with cassiterite; Bell Mount; Mt. Bischoff, with berthierite and chlorophane; Rosebery, with galena and blende; Mt. Read, with galena, blende, and huascolite; Heazlewood; Colebrook, with pyrrhotite in the limurite of the locality; Savage River, with magnetite and actinolite; Mt. Pelion; Mt. Balfour, with covellite; Mt. Farrell; but the most commercially important occurrences are those of a metasomatic nature in the vicinity of Mt. Lyell.

The most important sulphide ores of copper are the following, viz.:—

Composition.

	Cu	Fe	S		Crystallographic System.
Chalcopyrite	34·5	30·5	35	$CuFeS_2$	Tetragonal
Chalcocite ...	80	...	20	Cu_2S	Orthorhombic
Covellite......	66·4	...	33·6	CuS	Hexagonal
Bornite........	55·5	16·4	28·1	Cu_3FeS_3	Isometric
Cubanite......	23·3	41·3	35·4	$CuFe_2S_4$	Isometric
Pyrite	...	46·6	53·4	FeS_2	Isometric

A small proportion of the iron in the last is often replaced by copper, in which case it may be considered a poor ore of the metal.

72. CHALCOPHANITE (*Hydrated Oxides of Manganese and Zinc*).

Occurs in aggregates of small tabular rhombohedral crystals, commonly in druses and botryoidal masses. A usual habit is coating stalactitic iron-manganese, and often covering comparatively large areas in the gossan zone of the lode. At the Comet and other mines at Dundas it is of the most intense black colour with a highly brilliant lustre and velvety sheen. It is unquestionably one of the most attractive species amid a large group of handsome minerals. In the cabinet it rarely fails to attract attention, but from an economic standpoint it is valueless. Although it was so extremely abundant at the locality mentioned, it is in nature a mineral but rarely met with, and then never so fine and attractive as its occurrence in this State. At the Magnet Mine it occurs as a blue-black incrustation on psilomelane and other minerals. It sometimes coats the interior of small vughs, and occasionally has isolated crystals of cerussite attached to it. At all times it is interesting and attractive to lovers of the beautiful in nature.

73. CHALCEDONY. (See QUARTZ.)

74. CHALCOTRICHITE (*Fibrous Cuprite*).

This beautiful variety of cuprite occurs in capillary tufts of a bright crimson colour, usually surrounded by a thin coating of native copper in small cavities in the limurite rock of the Colebrook. North-East Dundas.

75. CHIASTOLITE (*Silicate of Aluminium*).

This is often classed as a variety of andalusite, which is of the same composition. The common form has been obtained sparingly, as knotted masses penetrating slate rock near its junction with the granite at Zeehan.

76. CHLORITE (*Hydrated Silicate of Aluminium and Magnesium*).

In schist, and as beautiful bright-green fan-shaped crystals in honeycombed quartz at Crown Lyell Mine. Species undetermined. Occurs pseudomorphous after felspar at Block 4891-93M, Ben Lomond (Waller, "Report on the Ben Lomond District," 1901). At the East Hercules, Mt. Read, a chlorite schist occurs, which in places is wholly that substance.

Occasionally abundant in stanniferous lodes at Ben Lomond and Heemskirk; at Bell Mount, west of Mt. Claude, with sphalerite; as chlorite schist it is abundant between Waratah and the West Coast. The substance occurring at Bischoff that is usually termed chlorite is a greenish tourmaline rock, which is characteristic of that locality.

A fibrous radiating variety occurs at Mt. Ramsay and Hampshire, the former of a pale-green and easily decomposable, the latter of a darker colour, more durable in nature. At the Laurel Creek, near Mt. Housetop, the mineral occurs as a vein in a mineralised dyke; it is of various colours and much stained with iron oxide. At the Prince George Mine at Heemskirk in sheaf-like aggregations, which cross each other, and are sometimes radiating; at the Hampshire Hills as chloritic porphyry, in two dyke-masses running almost parallel, which are traceable for a considerable distance. On the north-eastern tinfield this mineral is distributed, but usually in small quantity; it occurs as a constituent of protogine, a stanniferous rock, at Ben Lomond and Gould's Country.

Chlorite in reality forms a group of minerals which appear to merge one into the other, and they are at the best most unsatisfactory. The numerous varieties occurring in this island have not been carefully investigated.

A dark-green variety of chlorite occurs at Stony Ford, near George's Bay, which shows the unusual association of cassiterite with garnet, blende, and copper pyrites.

77. CHLOANTHITE (*Diarsenide of Nickel*).

A greyish-white isometric nickel mineral, remarkable for readily altering or sweating on the surface, when specimens are in a moist atmosphere, to the hydrated arsenate, which on giving off its excess of hygroscopic moisture apparently becomes annabergite. It occurs in limited quantity, with other nickel minerals, in the lower levels of the Long Tunnel Mine, Rocky River.

Several fair-sized masses of this mineral have been obtained from what has been reported to be a small lode situated on a mineral section known as the Central Balstrup, at Zeehan. They all show distinct, but somewhat distorted, isometric crystals, which are much intergrown.

78. CHONICRITE *(Hydrated Silicate of Calcium, Magnesium, and Aluminium).*

This is a substance with much the general appearance of ordinary chlorite, to which group it apparently belongs. In structure it is radiating, with a silky lustre, and is lavender-blue in colour. It is always accompanied by fine granular quartz. Several specimens were obtained as loose boulders; it has not been found *in situ*.

Locality: A tributary of the Rocky River, which stream falls into the Pieman.

79. CHROMITE *(Oxides of Chromium and Iron).*

This mineral is apparently widely distributed throughout the north-western portion of the island, but has not been recorded as occurring in large quantity. It is always to be found in more or less profusion wherever serpentine occurs, sometimes intermixed with that rock in the form of minute crystals, but more often as irregular patches of various sizes, which occasionally form somewhat extensive masses. At the Heazlewood it is fairly abundant in the massive form, but not, so far as exploited, in large quantities. Occurs in crystalline masses in a small vein occurring between serpentine and quartz, near the River Forth; at Harmon's Rivulet, Huskisson River, as small crystals as well as massive; Dundas, in limited quantity; plentiful in the bed of the Arthur River, below its junction with the Waratah River; in the serpentine at Anderson's Creek, Forth River, Styx River, and the head of the Florentine.

80. CHRYSOBERYL *(Aluminate of Beryllium).*

Variety *Alexandrite.*

A remarkably fine example, with a few of indifferent character, of this highly-prized gem-stone was obtained by Mr. J. A. Thomson at the Weld River, in stanniferous drift, during the ordinary process of dressing tin ore. It is of a somewhat pale but attractive green colour, red by transmitted light, as is characteristic of the variety. It was, by the kindness of Mr. Thomson, tested with the dichroiscope by Mr. W. H. Twelvetrees, Government Geologist, with the result that its identification was placed beyond doubt. It is remarkable that this is the first cut specimen which has come under notice. In all probability this gem has been looked upon as a pale transparent corundum, which is comparatively abundant at the locality, as is also the zircon.

81. CHRYSOCOLLA *(Silicate of Copper).*

This mineral usually occurs as a thin crust on other copper minerals. Colour: Various shades of emerald-green, passing to pale-blue. Obtained as a thin coating in small patches, Star of Peace Mine, Cascade.

82. CHRYSOLITE *(Silicate of Magnesium and Iron).*

This is also known as olivine. As a rule rocks containing this species are no good for the important metallic minerals, and its occurrence may with some certainty be looked upon as an indication of their non-existence. Large specimens form the green stone termed peridot, but those occurring here are usually too small to be of use to the jeweller. Found in pale-green semi-transparent particles in basalt, Dundas; in amygdaloidal basalt at Bischoff and the Wilmot River; Upper Forth River, massive in basaltic dyke: of a yellowish-green colour in coarsely crystalline dolerite, Paddy's Sugar Loaf Mountain (W. R. Bell); near Hampshire Hills; Deloraine; as somewhat large crystals, often a third of an inch in diameter, which are of a bluish colour and opalescent tarnish, in partially-decomposed basalt at the Emu River; commonly scattered as small blebs in black basalt, Table Cape; in large masses, often intermixed with zeolitic matter, Sheffield; in basalt at Derby, as well as in most basaltic rocks occurring in this island.

83. CHRYSOTILE *(Hydrated Silicate of Magnesium).*

Almost all of the locally termed asbestos belongs to this species; it usually occurs as seams and patches in serpentine. Abundant near Beaconsfield and the Asbestos Range. The fibres are occasionally up to 4 inches in length, pale in colour, silky and beautifully soft to the touch. It is easily separable from the more compact rock. Samples occasionally occur which show a gradual transition to hematite, with which it is closely associated. At the Heazlewood it abounds in the serpentine, but is short in fibre and amianthus-like. About Mt. Heemskirk it occurs wherever its parent rock exists, sometimes as short entangled masses of a white colour; in greater or less quantity at Mt. Claude and Dundas; and it is said to occur east of the Mussel Roe River, North-East Coast.

84. CIMOLITE (*Hydrous Silicate of Aluminium*).

A white clay-like substance, apparently identical with that known under this name, occurs as a deposit near St. Leonards, and is often termed locally "meerschaum." It is of a smooth compact texture, with a dead-white colour and subconchoidal fracture.

85. CLINOCHLORE (*Basic Silicate of Magnesium and Aluminium*).

A monoclinic member of the chlorite group that often occurs in fairly well formed, large crystals. It has a distinct micaceous structure and a somewhat pearly lustre.

Near North Mt. Heemskirk it occurs in large masses that occasionally show crystalline bunches, with a sporadic well-developed crystal. The colour is the characteristic pale metallic-green. At Anderson's Creek it occurs in minute, almost microscopic, radiating bunches of a shade of green that is somewhat darker than usual (W. H. Twelvetrees).

86. COAL.

River Don; Mersey; Port Arthur; Seymour; Schouten Island; South Cape; near Waterhouse; Three Hut Point; New Town; York Plains; Eastern Marshes; Jerusalem; Cullenswood; Mt. Nicholas; Sandfly; Adventure Bay; Port Cygnet; Hamilton; Richmond; Prosser's River; Spring Bay; Mt. Munro; Fingal; Longford; Jericho; Inglis River; Mersey River; Western Bluff; Gad's Hill; Magnet Range; Henty River.

Full detailed descriptions of our bituminous coal measures, with numerous analyses of samples, will be found in the Proceedings of the Royal Society of Tasmania, 1851, Johnston's "Geology of Tasmania," 1888, and in the Tasmanian Official Record, 1892; also in the geological reports published by the Mines Department.

Variety *Anthracite*.

"This occurs in irregular grains up to ¼-inch in size, enclosed in calcite and siderite, in the abandoned lead mine North Valley, Mt. Bischoff. The grains are of dense black colour with splendent lustre, and frequently iridescent tarnish; fracture conchoidal. This interesting and rare occurrence of a mineral coal in an ore-lode is also recorded from ore-lodes of several mining districts in Germany" (Ulrich).

In the workings of various quartz reefs in the Beaconsfield goldfield a hydrocarbonaceous substance occurs which has been identified as anthracite by Mr. F. Danvers Power, F.G.S., and as a variety of lignite by Mr. A. Montgomery, M.A., Government Geologist, and Mr. W. F. Ward, A.R.S.M., Government Analyst ("Notes on a Carbonaceous Deposit in Silurian Strata at Beaconsfield, Tasmania," Pro. Australasian Association for the Advancement of Science, 1892). The material is from a dark-brown to an entirely pitch-black colour, extremely pulverulent, shining, and has occurred at times in rather large quantity.

Messrs. Montgomery and Ward state (*loc. cit.*):—"Two main lines of quartz reef traverse the Cabbage Tree Hill, one worked by the Amalgamated West Tasmania, Moonlight, Olive Branch, and Little Wonder, in all of which mines the substance has been obtained. It occurs in the Tasmania in hard beds and patches of a coarse quartz grit in the principal workings of the mine; in the Moonlight at a depth of over 422 feet from the surface. It is also found in the cracks and joints of the gritty masses to quite 90 feet below the present sea-level." Messrs. Montgomery and Ward consider that the substance is not older than the Tertiary epoch, but it may be of much greater geological age.

"The average composition was found by analysis to be as follows:—

		Per cent.
Carbon	=	38·91
Hydrogen	=	3·03
Oxygen and nitrogen (by difference)	=	21·60
Sulphur	=	2·36
Ash	=	12·00
Moisture, lost at 100° C.	=	22·10
		100·00"

87. Cobaltite *(Arsenide of Cobalt and Iron).*

This mineral occurred in small patches, with pyrites, galena, and grey copper ore, at the old Penguin Silver Mine, Penguin River (James Smith). It has also occurred, but in very small quantity, embedded in schist near Lake Dora.

88. Copalite *(Fossil Resin).*

A brownish-yellow, hydro-carbonaceous substance with a semi-pearly sheen. It is very brittle, soft, and of uneven fracture. When heated it melts to a dark-brown varnish-like mass, burning with a yellow flame, during which it gives off much smoke, at the same time emitting a strong, resinous, aromatic odour. A sample was submitted to Professor Krausé, late of the Ballarat School of Mines, who stated that it comes near a fossil resin known as middletonite, and that a similar substance has occurred in coal in Victoria. It is found in lumps which vary in size from extremely small to, in rare instances, masses weighing a few pounds. It occurs impregnating beds of lignite at Macquarie Harbour.

A fine large mass of a similar substance was obtained from alluvial tin workings at Cape Barren Island. It has also occurred with lignite and slate (containing leaf impressions) at the old Don Tin Mine at Mt. Bischoff, and also, with lignite, near Evandale Junction.

89. COPIAPITE (*Yellow Sulphate of Iron*).

This sulphate occurs in limited quantity, as a result of the alteration of melanterite, in the old levels at the Mt. Bischoff and other mines. It is commonly found as an incrustation in melanterite, being a transmutation of that mineral by loss of water. Cabinet specimens of pyrites often decompose to this and other sulphates. In the vicinity of Barn Bluff much of the schist rock of the locality is more or less impregnated with decomposable pyrites which soon alters to the sulphate.

90. COPPER, Native.

The native metal is cubic and holosymmetric. The crystals are commonly much elongated, and occur in more or less crystallised groups. It is plentiful at several localities on the West Coast. At Mt. Lyell and vicinity it has been found in considerable abundance, individual specimens often weighing several pounds, and in extreme instances reaching to as much as from 70 to 80 lbs. At the Lyell Blocks Mine it has been mined on the large scale. At this mine it occurs embedded in a fossiliferous lithomargic clay of various tints. It is occasionally auriferous at this locality. At Mt. Bischoff a highly-polished native copper foil of extreme tenuity has been obtained coating the cleavage faces of the killas or metamorphic slate, near its junction with the porphyry dykes. At the Montagu and Duck Rivers this metal occurs as small lumps and filmy scales, irregularly dispersed throughout a dark-coloured igneous rock (diabase?); also at Birch's Inlet, on Macquarie Harbour, under the same conditions. It occurs in a vein of garnet at the Hampshire; with barite at the Wilmot River; as a flaky coating on limonite at Nolan's Creek, near the Pieman; in chlorite, with blende and galena, at Laurel Creek, which is a tributary of the Blyth River. At the Dunyan Range, near Circular Head, small quantities have been obtained. At the Rio Tinto Mine, Savage River, it occurs with magnetite and actinolite, much of the metal at this locality being in the form of felted masses that are composed of capillary filaments. At the Argent River, near the Renison Bell Tin Mine, native copper occurs cementing together granular quartz and other rock fragments, the patches of rock being at times almost encased with the metal. It also occurs at numerous other localities in small quantity, but not, so far as known, of any special importance.

91. CORUNDUM *(Oxide of Aluminium).*

A well-known mineral occurring in many varied colours, several of which have received well-known appellations, such as ruby, sapphire, corundum, and emery. It answers to the formula $Al_2 O_3$, and crystallises in the rhombohedral system. Its common mode of occurrence as crystals is in six-sided prisms, which very rarely exhibit any tendency to flat triedral terminations. It is more commonly granular or in the amorphous condition, or again as small rolled fragments. It may be opaque to translucent, and is sometimes almost colourless; but it usually shows some tint of grey, brown, or greenish, with an occasional chatoyant lustre. The term corundum is by common use confined to the dull-coloured opaque variety, and emery to the granular dark-coloured form that is usually intermixed with magnetite. The ordinary dull-brown coloured form of this mineral is often met with in the stanniferous drifts of the north-east mining district. It gradually merges in tint and translucency to the clear blue sapphire, although clear gemstones of the highly valuable Oriental standard are of exceptional occurrence. Nevertheless fine coloured stones have been and are still found, that are almost, if not quite, equal to the average from the East. The colour of the gem as occurring in this island varies through all shades of blue, green, and purple, and they are not rarely parti-coloured—at times showing tints of blue and yellow in the same stone. The valued asteriated variety is not uncommon. A somewhat fine example of the parti-coloured sapphire was obtained in the Weld River, weighing 264 carats, and stones, often of remarkably good colour, are not rare weighing from 4 to 12 carats. Many of the stones have been cut and mounted, but the trade in them is extremely limited. The sapphire has not been detected *in situ*, although the granite of the mining districts may fairly be considered its matrix.

The amethyst and ruby of the Oriental or corundum variety are not known to occur, but the Oriental topaz has been obtained at Main Creek and the Weld River. Prominent localities are Mt. Cameron; Thomas' Plain; Weld River; Main Creek; Branxholm; and Moorina; all on the north-east alluvial tin-mining fields. At the Blyth River, corundum occurs in the opaque form from almost colourless to dirty-blue and grey. At Boat Harbour, near Table Cape, clear blue, rolled fragments occur intermixed with zircon and quartz. Near Bell Mount in the Middlesex district a few small fragments of opaque corundum have been obtained, and the same remark applies to several other localities.

92. COSSYRITE *(Titanosilicate of Sodium, Iron, and Aluminium).*

This is a triclinic amphibole, of somewhat rare occurrence. It is found as irregular microscopic shreds, with prismatic and hexagonal sections, of a dark red-brown colour, as an accessory in the garnetiferous-mica-sölvsbergite of the peculiar alkaline rock plexus of Port Cygnet.

93. COVELLITE *(Sulphide of Copper).*

The cupric sulphide (Cu S) is usually found as a blue incrustation on other copper-bearing sulphides. It is a secondary mineral, principally derived from the alteration of chalcopyrite and bornite. It is commonly known as indigo copper ore, since it resembles indigo in general colouration. It has been found at the Cascade and at Blue Tier, in association with cassiterite, in the porphyry and granite rocks. At Murray's Mine, near Mt. Balfour, it is a well-recognised enrichment of the prevailing yellow copper ore. At the Heazlewood it has occurred in limited quantity, and is known in several other localities.

Respecting the mineral mixture of covellite, tenorite, &c., that occurs at the North Lyell Mine, Mr. R. Sticht writes: "It is of special interest, because it occurs at the 500-feet level of the North Lyell Mine. In that mine nearly all the ore is of a sulphide nature, so that this is a somewhat unique occurrence in the mine."

The analysis is as follows:—

		Per cent.
Silica	=	43·2
Iron	=	6·8
Sulphur	=	13·4
Copper	=	31·5
Not determined, but probably oxygen	=	5·1
		100·0

Assuming that the foreign matter merely consists of quartz and iron pyrites, which is correct as far as we can see with the naked eye, the specimen shows the following composition as a whole:—

		Per cent.
Quartz	=	43·2
Iron pyrites ($Fe S_2$)	=	14·59
Covellite ($Cu S$)	=	16·73
Tenorite ($Cu O$)	=	25·50
		100·02

Taking into account only the mineral portion, the mixture would seem to consist of—

		Per cent.
Iron pyrites ($Fe S_2$)	=	25·00
Covellite ($Cu S$)	=	30·00
Tenorite ($Cu O$)	=	45·00
		100·00

The point of interest is that these decomposed and oxidised products occur at such a low level in a sulphide mine. Of course the occurance is very restricted. At the surface of the North Lyell ore-bodies there is very little similar material present, if any.

94. CROCOISITE *(Chromate of Lead).*

No mineral discovery *per se* has accomplished so much in advertising this State amongst mineralogists and those interested in geological science as crocoisite. It is at once one of the most beautiful in colouration as well as most perfect in crystallographic growth that the world has produced, far surpassing that from the original classic locality in Siberia. As has been well remarked, "With their superb colour, high lustre, and remarkably perfect crystallisation, they are the most beautiful natural objects, scarcely surpassed by crystals of any other known mineral."

The first discovery of the mineral was made about the year 1895 by Messrs. Smith and Bell at the Heazlewood Silver-lead Mine. It there occurs in bright, shining, hyacinth-red crystals, small as we now know them from other portions of the island, arranged in acicular bunches, penetrating and attached to a very friable clayey gossan, intermixed with a little cerussite, and more rarely pyromorphite. They then occurred at the Whyte River Mine more plentifully, and often intermixed with the soft country-rock on both walls of the lode as well as in its capping. The crystals often coated the fractures and cleavages. Patches of the doubly-terminated monoclinic crystals of small size, but perfect form, have been repeatedly obtained. Some of the specimens were of an unusually pale colour, and perceptibly faded upon exposure, a characteristic not noticeable in the Dundas occurrence. At the Magnet Mine this mineral is plentiful in the oxidised lode capping, sometimes in the form of entangled masses of fine prisms, 2 to 3 inches in length, and less frequently in loose, perfectly terminated crystals of small size. In vughs, coated occasionally with black manganese oxide, the crocoisite crystals were intimately associated with yellow cerussite and other salts of lead. At the Adelaide Mine at Dundas an enormous quantity was passed through and partially mined. It was of good colour, and freely attached to and intermixed with cerussite of a pale-yellow colour and local habit. Psilomelane and massicot were often companions, which tended to add variation to the beauty of the specimens. At times patches of the rare and local dundasite were peppered over with exquisitely beautiful little crystals of the chromate. The most important find of all, both as regards quantity and quality, occurred at the Dundas Extended and the West Comet Mines. Here it was obtained in the greatest profusion, many of the enormous crystals reaching the unparalleled length of 10 to 12 centimeters, with perfect terminations. These naturally caused a mild sensation when available to mineralogists in all parts of the world. They were extremely brilliant, of an intense scarlet colour, and translucent to almost transparent. The varied crystal forms have been studied and described by Palache, Van Name, Anderson, and others. The crystals have been known to have various types of terminations from a single face (clinadome ʒ) to as many as six or seven terminal planes. The lode outcrop of the Central Dundas Mine was of considerable height above the natural surface, and through its ferruginous mass large isolated crystals of crocoisite were found. They were often intimately mixed with masses of chalcophanite and manganese oxides. This wonderful find is now practically exhausted, and it would need much exploratory work to attempt to discover another patch. The species has only been reported to occur, and then in extremely limited quantity, at the Colonel North and Silver Queen Mines on the Zeehan Field. At both mines it was obtained as small crystals in gossan. A small quantity is said to have been detected at Broken Hill, New South Wales, and it is known to occur in association with free gold in Western Australia.

The origin of the chromic acid of the crocoisite has hitherto been somewhat of a mystery, but it may be explained by the presence in the undolomitised websterite, in which the Magnet lode occurs, of numerous irregularly dispersed well-formed crystals of picotite (chrome spinel) of an intense black colour and high lustre, which on decomposition have doubtless afforded the chromic acid essential for the secretion of the chromate. The Magnet silver-lead bearing fissure lode occurs in a dyke of more or less, but generally completely dolomitised websterite rock, which traverses slates of Cambro-Ordovician age. The lode filling essentially consists of dolomite, siderite, ankerite, and rhodocrosite, usually arranged in remarkably regular vertical laminations with a central crustification, and in part is not rarely coloured by green chromic acid. The dolomitisation of the websterite would appear to have had the effect of decomposing the picotite, as no trace of this mineral is observable where the alteration is well advanced, but the whole is distinctly stained in numerous places throughout the mine a more or less intense green colour by $C\,O_3$. The Heazlewood occurrence of crocoisite is likewise in a lode, occurring intimately associated with green chrome-stained dolomite. The picotite at this locality occurs plentifully distributed in the adjacent serpentine; so much so that it may be collected in considerable quantity in the detrital material in the streams.

At Dundas the metalliferous lodes from which the mineral has been collected in such remarkable profusion and unusual development are closely connected with an intensely green serpentine rock, in which the chrome-bearing mineral is known to occur. At the Adelaide Mine green-stained dolomite also occurs in connection with the lode, and has been plentifully produced in the ordinary mining operations. It may be mentioned that chromite ($Fe\ Cr_2O_4$) occurs in moderate quantity throughout the serpentine area of the Heazlewood district, but is not known in the vicinity of the Magnet.

The small doubly terminated crystals of crocoisite from the Magnet locality have been studied and described by Dr. C. Anderson, M.A., B.Sc. ("Records of the Australian Museum," Vol. VI., Part 3). He states:—"The matrix is a rather friable limonite, in which the crocoisite is partly embedded. The largest specimen carries numerous crystals about 2 mm. in length; in the other cases, where *in situ*, the crystals are quite minute. . . . Qualitative analysis proves their composition to be chromate of lead, and, like the larger crystals, they agree morphologically with crocoisite. The habit is remarkably constant throughout, the crystals being prismatic by extension along the zone axis *bt*. This zone, being the only well-developed one, was made equatorial, and a stereogram constructed from the co-ordinate angles obtained. From this the forms were identified by means of Penfield's protractors, and the identification was confirmed by calculation of the normal angles. All the faces are small, with the exception of *t* (111) which gives an excellent image and a peculiar rounded face, which could not be determined, but is possibly *x* (301); the pinacoid *b* (010) is very small when present." The Dundas crystals have been fully studied and described by C. Palache ("American Journal of Science," 1896, page 389), who states respecting the crystals from the Adelaide Mine, Dundas: "The specimens were implanted on limonite, and consisted of numerous crystals clustered upon bases of lamellar gangue. The crystals are of a light hyacinth-red colour, quite translucent, and with adamantine lustre. They vary in size from minutest needles to prisms of 2 cm. and 3 mm. diameter. The habit is prismatic and the crystals are never doubly terminated, being attached at one end to the limonite. The larger crystals are often cavernous, giving rise to hollow prismatic forms. As is usually the case with crocoisite, the crystal planes are even and brilliant, giving good reflections on the goniometer. The faces of the prism zone are, however, strongly striated, parallel to the prism edges, and this renders the identification of some forms doubtful. Four crystals were subjected to measurement, and shewed the following forms, most of which were present on each crystal. The letters used are those of Dana:

m	(110)	*I*	*K*	(101)	1 — ì
f	(120)	*i* — 2̀	*5*	(011)	1 — ì
d	(210)	*i* — 2	*w*	(012)	½ — ì
**S*	(10·3·0)	*i* — $\frac{10}{3}$	*y*	(021)	2 — ì
**T*	(530)	*v* — $\frac{5}{3}$	*t*	(111)	— *I*
b	(010)	*i* — ì	*v*	(111)	*I*

The following table shows some of the measurements and the angles calculated from Dauber's elements:

		Calculated.			
m ∧ *m*	110 ∧ 110	86° 19′	86° 14	14	85° 59′ 86° 31′
5 ∧ *5*′	011 ∧ $0\bar{1}1$	83 38		1	
w ∧ *w*′	012 ∧ 012	48 12		1	
y ∧ *y*′	021 ∧ $0\bar{2}1$	121 40		1	
k ∧ *v*	$\bar{1}01$ ∧ $\bar{1}11$	35 41		1	
T ∧ *b*	5·3·0 ∧ 010	59 55		1	
S ∧ *b*	10·3·0 ∧ 010	74 13		3	73° 7′ 15′

The two prisms (10.3.0 and 5.3.0) were represented by exceedingly indistinct faces, reflections from which were only dimly visible with the δ ocular of the Fuess instrument. The first form *S* (10.3.03) is unrecorded; the second, *T* (5.3.0), is enumerated among doubtful forms by Dauber. The remaining forms are in about an average development; but their proportions vary widely in various crystals with either *t* (111) *v* (111), or forms of the clinodome zone predominating. This combination of forms is exceedingly like that shown by Dauber (Berichte Akad. Wien., XIII., fig. 93, Pl. 11, 1860) on crystal of crocoisite from Berezov in the Ural, which is somewhat surprising considering the widely different paragenesis of the mineral in the two localities.

95. CUBANITE *(Sulphide of Copper and Iron).*

Much of the cupriferous pyrites occurring at many localities in the western mining fields in reality belongs to this species. It is cubic in crystallisation, although commonly occurring massive and disseminated. It is much lower in copper and higher in iron contents than chalcopyrite, the empirical analysis given by Dana being S 35·4, Cu 23·3, Fe 41·3 = 100. Common at the Mt. Read mines; Mt. Balfour; and Mt. Lyell.

96. CUPRITE *(Red Oxide of Copper).*

In the vicinity of Mt. Lyell this mineral occurs in some abundance in finely-formed isometric crystals, which, both as regards size and colouration, are of the prevailing octahedron habit and its modifications. They are often attached to or partially embedded in blocks of nodular limonite, and occasionally the cavities in the nodules are literally coated with the bright, sparkling mineral, which from its ruby colour contrasts well with the brown iron oxide. The latter is often stained a shining black with manganese oxide and stilphnosiderite. Recently obtained in considerable quantity, intermixed with iron oxide (tile ore), at the Eastern P.A. Mine, Scamander River; also in limited quantity at Curtin-Davis Mine, Dundas.

97. CYANITE *(Silicate of Aluminium).*

A pale-blue mineral, crystallising in the triclinic system, and usually occurring as long, bladed, four-sided prisms, which are irregularly terminated, and embedded in mica-schists. It has been detected at Clayton's Rivulet, River Forth.

98. CYANOSITE *(Sulphate of Copper).*

Originates from the decomposition of cupriferous sulphides; generally occurs stalactitic or as an amorphous efflorescence in old mine workings. Colour: Various shades of blue to bluish-green. From adit, North Valley, Mt. Bischoff; Gad's Hill Range, Upper Mersey River, after a brass-yellow variety of chalcopyrite, often intermixed with blebs of galena and blende; Rio Tinto, Savage River, and the old drives at the abandoned Australasian Slate Quarry, Back Creek, at which place it is commonly intermixed with the black oxide of copper; in the No. 4 level at Mt. Lyell, as an incrustation derived from the leaching of cupriferous pyrites in the country-rock.

99. DAMOURITE *(Hydrated Silicate of Aluminium and Potassium).*

A rock-forming mineral of common occurrence; it is an altered muscovite-potash mica which forms one member of a group of alteration products often termed hydromicas. It has a pearly lustre and unctuous feel, after the manner of ordinary talc. It passes from the distinctly fibrous variety known as sericite to that of a compact nature which is termed pinite. It may not only be derived in some of its forms from the alteration of muscovite, but is not rarely also produced by the alteration of other minerals. Occurs in the Mt. Lyell schists. (J. W. Gregory, "The Mount Lyell Mining Field," Aus. In. Mining Eng., Melbourne, 1905.)

100. DANBURITE *(Silicate of Calcium and Boron).*

This uncommon mineral crystallises in the orthorhombic system, and is always pale in colour, of some shade of yellow to almost colourless. It occurs sparingly with the next species in the limurite of the Colebrook, Dundas.

101. DATOLITE *(Basic Orthosilicate of Boron and Calcium).*

This species crystallises in the monoclinic system. Occurs in glassy crystals and crystalline aggregates; has a vitreous lustre, and is always of pale colour, usually a shade of the palest green. It is of secondary origin, possibly formed after axinite and calcite, with which it is closely associated at its only locality in this island, viz., the Colebrook Mine, North-East Dundas.

Writing of this Dr. C. Anderson states ("Records of the Australian Museum," Vol. VI., Part 3): "The mineral was first obtained in sinking a shallow shaft in the western portion of the limurite outcrop. It is found associated with axinite, calcite, and other minerals as already described under axinite, and sometimes occurs in large brilliant crystals. It is colourless, greenish, or yellowish. Crystallography.—The crystals have mutually interfered during growth, but one small projecting crystal was found and measured. . . . The habit of the figured crystal seems characteristic so far as can be judged by inspection of others; it is prismatic by extension parallel to the *a* axis, and measures about 6 mm. in length. It is fairly rich in forms, but, as is usual with datolite, many of the faces are wavy, and give but poor reflections. The three faces *b* (212), π (231), and *x* (102) are dull, and were measured in the position of maximum illumination."

The result of Dr. Anderson's analysis was as follows, viz.:—

		Per cent.
H_2O	=	6·48
SiO_2	=	36·28
Al_2O_3 Fe_2O_3	=	·95
CaO	=	35·21
B_2O_3	=	20·48
		99·40

102. DEWEYLITE *(Hydrous Basic Silicate of Magnesium).*

This is an amorphous, greasy, smooth, and translucent substance, which in colour affects the paler shades of yellow, brown, and bluish. It is brittle and commonly much fractured, and at times it appears as if in layers. It contains more water than serpentine, of which it appears to be an alteration product. It occurs in rather narrow seams, at times reaching to as much as a foot in width, traversing and closely connected with serpentine.

Locality: Harmon's Rivulet, near Parson's Hood Mountain. It also occurs in the vicinity of North Mt. Heemskirk.

103. DIALLAGE *(Silicate of Calcium and Magnesium).*

A rock-forming pyroxene, which occurs in various shades of green, grey, and brown. Its lustre is vitreous and occasionally rather pearly. It forms extensive ultra-basic masses on the west side of the Heazlewood River, and in the vicinity of the Hampshire Hills; also as a constituent of the gabbroid rocks at the Whyte River, Mt. Agnew, and at Dundas.

104. DIALOGITE *(Carbonate of Manganese).* (See RHODOCHROSITE.)

105. DIAMOND *(Pure Carbon).*

It is beyond doubt that several veritable diamonds have been discovered in this island at a locality on a small tributary of the Pieman River, and at Harvey's Creek, which falls into the Savage River and also flows into the Pieman. They were obtained in alluvial drift with a little gold. All the specimens obtained showed good crystallisation, of the prevalent octahedral form, with the characteristic rounded facets. They presented a remarkable uniformity as to size, nearly all being about $\frac{1}{16}$-carat in weight, although one reached $\frac{1}{4}$-carat, and all have one exact tinge of yellow, although one or two had a tendency to be paler at the apices of the crystals. They were obtained in shallow alluvial and quartz grit and clay, and did not show any appreciable amount of attrition. The total number found which can be satisfactorily authenticated does not exceed sixteen, or at the outside eighteen. Altogether not less than seven have passed through the writer's hands. When several were tested by being placed within the influence of a tube containing radium bromide of 1,000,000 strength, all exhibited the strong glow of incandescence which is peculiar to the substance under radium emanations. Tradition has it that many years ago a parcel of gem sand from the Hellyer River was sent to England by the Van Diemen's Land Company for expert examination, and in it was found a single minute specimen of the diamond; but this has not been authenticated. It may be mentioned that a presumably careful examination of Harvey's Creek, from which two or three of the small specimens were obtained, failed to reveal any of a larger size.

106. DIASPORE *(Hydrate of Aluminium).*

This mineral crystallises in the orthorhombic system, but is usually in the amorphous state. A substance having the general physical characteristics of this species was obtained by Mr. A. Montgomery, late Government Geologist, at the tip-head of that portion of the Bischoff Tin Mine known as the Stanhope.

107. DIOPSIDE *(Metasilicate of Calcium, Iron, and Magnesium).*

This is an almost white, to various shades of green, variety of augite. It is at times quite translucent. It occurs both massive and crystallised at the mine known as the Tenth Legion, Comstock district.

Analysis:—

Per cent.

SiO_2 = 52·1

Al_2O_3 = 3·0

MgO = 15·0

CaO = 27·7

FeO = 2·3

100·1

Specific gravity, 3·23; hardness, about 6. (G. Waller: "Report on the Iron and Zinc-lead Ore-deposits of the Comstock District," Feb. 1, 1903—Mines Department.)

108. DOLOMITE *(Carbonate of Magnesium and Calcium).*

The pure crystallised form is of exceptional rarity, but the ordinary massive kind is of common occurrence, and is sometimes met with in considerable quantity. The gangue of the silver-lead lodes of the Heazlewood and Dundas districts is often composed of an irregular mixture of brownspar, siderite, and calcite, with a limited quantity of quartz, most of which is more or less stained with the oxides of chromium and nickel. At Dundas a blue-coloured variety has been obtained associated with galena. The massive form occurs at Mt. Claude, near Mt. Pelion, Heazlewood, and Dundas.

A somewhat unusual occurrence, in the form of small attached, doubly-curved, or saddle-shaped crystals, which are opaque and white (Magnet Silver Mine, Magnet). Analysis of the pure white form from the Magnet Mine (F. O. Hill):—

Ca O	31·72	per cent.	=	Ca Co$_3$	56·64	per cent.
Mg O	15·60	„	=	Mg Co$_3$	32·76	„
Fe	3·92	„	=	Fe Co$_3$	8·26	„
Mn	1·80	„	=	Mn Co$_3$	3·76	„
					101·42	

109. DUFRENITE *(Phosphate of Peroxide of Iron).*

Occurs as a thin, irregular encrustation, of an olive to blackish-green colour, on siderite at the Bell's Reward Mine, Heazlewood.

110. DUFRENOYSITE *(Sulpharsenite of Lead).*

This mineral was obtained as thick orthorhombic crystals, which are deeply grooved longitudinally, colour lead-grey, highly polished, and occur implanted on and in the cavities of crystalline siderite. Several of the beautifully developed crystals exceeded 1 inch in length and ⅜-inch in width.

Locality: Block 291, North-East Dundas.

Analysis:—

		Per cent.	
Pb	=	32·88	
Cu	=	9·08	
As	=	21·60	
Sb	=	8·53	
Fe	=	6·42	
S	=	21·79	
Ag	=	0·22	= 73 oz. 3 dwt. 11 gr. per ton.
		100·52	

111. DUNDASITE (*Hydrated Carbono-phosphate of Lead and Aluminium*).

This new mineral compound forms an incrustation on ferro-manganese gossan. It is composed of small spherical aggregates, usually closely matted together. Under the lens these bunches show an extremely fine radiating structure. The colour internally is silky milk-white, with a velvety outer crust of a dusty yellow brown. The surface often has numerous adherent crystals of crocoisite, which not rarely penetrate the mass. These crystals are always minute, but remarkable for their extremely fine development and acute angles. Its general habit of occurrence is in somewhat small rounded aggregates, which show white radiating tufts on separation. It is easily disintegrated into fine silky fibres after the manner of chrysotile. In many instances the individual tuft has as a nucleus a minute crystal of the bright hyacinth-red coloured crocoisite, which is again sometimes implanted on its surface. It often occurs coating the interior of vughs in the harder gossan. It is sometimes coated with a bright green film of extreme tenuity; this is probably a substance allied to pyromorphite. Again it is more rarely stained on the exterior with a salt of copper to a pale bluish-green, and still more rarely discoloured by brown hydrated iron oxide.

The qualitative reactions of this new substance are as follows:—In the matrass it becomes yellow and yields water. It is infusible before the blowpipe, but on coal, with fluxes, yields a considerable quantity of metallic lead, and coats the surface with the characteristic yellow sublimate. When moistened with sulphuric acid it gives distinct reaction for phosphoric acid. In nitric acid it dissolves with strong effervescence; the residuum from the solution strongly deflagrates and gives phosphoric reaction. The powdered material, when moistened with cobalt nitrate, clearly shows the beautiful blue colouration of alumina. With limewater gives the turbidity of carbonic acid. Hardness about 2.

Locality: Adelaide Proprietary Mine, Dundas.

The following is a complete analysis of this new species:—

		Per cent.
Pb = 38·84 per cent. =	$Pb\ O$	41·86
	$Al_2\ O_3$	26·06
Fe = 3·85 " =	$Fe_2\ O_3$	5·50
	$H_2\ O + Co_2$	28·08
		101·50

Formula for this species—

$$Pb\ O\ Al_2\ O_3\ 2CO_2\ 4H_2\ O.$$

The Fe_2 and O_3, or a portion thereof, may be foreign to the substance, as it is next to impossible to perfectly separate it, since it almost invariably occurs as an incrustation on the mineral from the original locality at Dundas. A trace of P_2 O_5 was also found; this was certainly obtained from an extremely thin coating or skin of pyromorphite, which is often present, and gives an external green colouration to the surface of the mineral. At the Hercules Mine, Mt. Read, a mass of snow-white cellular quartz has been obtained, throughout which are scattered crystals of cerrusite, gibbsite, and numerous patches of dundasite, the whole forming one of the most attractive associations of minerals as yet obtained in this State.

Referred to in Dana, "First Appendix to the Sixth Edition of the System of Mineralogy," page 23.

This mineral has been more recently found at the West Foxdale Mine, Trefriw, Carnarvonshire, Wales, by Mr. H. T. Collins (G. T. Prior, Mineralogical Society, 1905, and "Nature," April 13, 1905). Thus we have the novelty of a new Tasmanian mineral being subsequently discovered and recognised in Wales.

112. ELAEOLITE *(Orthosilicate of Sodium, Potassium, and Aluminium).*

The coarse massive form of nepheline. It is compact, with a greasy lustre. It occurs as an essential of several of the alkaline rocks of Port Cygnet.

113. EMBOLITE *(Chlorobromide of Silver).*

Found in limited quantity, but at times quite pure. As is usually the case, well-formed crystals are difficult to obtain, but moderately good specimens are not rare. Occurs intermixed with ferro-manganese gossan and earthy lode-matter. The more important localities are the following mines: Central Dundas and West Comet at Dundas; the Queen, Sylvester, and Junction at Zeehan; the Godkin, Washington Hay, and Whyte River in the Heazlewood district; and the Beulah at Scamander River.

Embolite merges gradually into cerargyrite, the two species being isomorphous. The mixtures occur both here and in Australia in varied proportions, so that the one species may gradually merge into the other. In minute but perfectly cubical crystals, which are occasionally octahedra. It occurs in an irregular seam of gossan at the Magnet Silver Mine, Magnet.

114. **Enargite** *(Sulpharsenide of Copper).*

It is only known in the massive state as occurring in this island, the orthorhombic crystals not having been detected. The usual colour of this mineral is iron black, with a distinct metallic lustre and black streak. The fracture is uneven and somewhat brittle. It has been obtained in small masses, intermixed with arsenical pyrites and fahlerz, at the Curtin-Davis Mine, North-East Dundas. It also occurs in limited quantity with other ores of copper at the Mt. Lyell Mine.

115. **Endlichite** *(Chlorourseniate and Vanadate of Lead).*

Found as minute, milk-white, hexagonal crystals at the Heazlewood and Magnet Silver-lead Mines. It is somewhat rare.

116. **Enstatite** *(Silicate of Magnesium and Iron).*

A rhombic pyroxene, apparently synonymous with bronzite. Occurs in subcrystalline masses of considerable extent in connection with serpentine at the Heazlewood, with other allied forms of almost similar chemical composition; abundant with its varieties, Huskisson River; Parson's Hood; Magnet Range.

117. **Epidote** *(Silicate of Iron and Calcium).*

Crystallises in the monoclinic system. It is always some shade of yellow-green. This mineral frequently occurs in richly metalliferous rocks, and in a lesser degree it is widely diffused. It is usually of a peculiar and characteristic pistachio-green colour, but it often affects a reddish-brown shade when occurring in serpentine. Common in greenstone west of the River Leven and at other places (J. Smith); abundant in clefts of rocks, Magnet Range; near Table Cape; about the River Forth; vicinity of Mt. Bischoff; with quartz as veins in an igneous rock, usually occurring in bunches of crystals (some of the individual specimens often met with up to an inch in length), Dunyan Range, Duck River; Woolnough, of clear colouration, but small size. At the Whyte River it has been found in the clefts of lode material with bunches of calcite and pyrites; at Dundas it is fairly abundant in quartz. Occurs very well crystallised, and of good colour, on the Melba Flat, North Dundas. At Calstock, near Deloraine, it occurs sparingly in quartz. In the vicinity of the Round Hill Silver-lead Mine, near Mt. Claude, this mineral is fairly abundant, occurring in connection with a dense white quartz (W. H. Twelvetrees). It has also been recorded from the Mt. Lyell district.

118. EPSOMITE *(Sulphate of Magnesium)*.

Found as sub-crystallised, aggregated, and delicately fibrous masses, but also commonly as a more or less compact incrustation. It occurs in caverns and rock-fissures, and is derived from saliferous rocks. Abundant in the neighbourhood of the Dromedary Mountain; about the Upper Lake River; near the Western Tier; at Exton; Alum Cliff caverns, near Chudleigh; Kangaroo River, near Campania, in a considerable deposit (Montgomery).

119. ERYTHRITE *(Arsenate of Cobalt)*.

This mineral may be at once known by its characteristic peach-blossom colour. An extremely small quantity has been obtained, intermixed with earthy ferruginous gossan, at the Penguin Silver-lead Mine, Penguin River; and in small patches of distinct colouration as a coating on lode gangue, probably derived from the transmutation of an arsenide, at the Hampshire Silver Mine, Hampshire Hills (W. R. Bell). Also occurs coating schist, Lake Dora.

120. EUDIALITE *(Metasilicate of Sodium, Calcium, Iron, and Zirconium Oxychloride)*.

Described by Dr. F. P. Paul as an essential in the nepheline-eudialite basalt of the Shannon Tier. The rock is greenish-grey coloured, and close-grained, and is considered by Dr. Paul as a distinct type of basic effusive, which is of extremely unusual occurrence, if not unique. It is a phase of the interesting rocks of the locality to which it is apparently confined. It occurs in the conical outcrop locally known as the "Beehive." The eudialite is colourless, and as accessories sodalite and apatite occur. The $Zr\,O_2$ = 0·21 of the mass, or 2 per cent. of the rock consists of the mineral in question. It is also found as an occasional accessory in the melilite-nepheline-basalt of the same locality. In the lastmentioned rock an apparently new mineral also occurs, which Dr. Paul states is related to olivine. According to that petrologist the analysis is $Ca_5Si_2O_9$, but he regards $Ca_2\,Si\,O_4$ as highly probable. In thin section it is colourless to light-grey in large irregular individuals. Refraction and double refraction rather strong, and differ little from those of the ferruginous olivine. Its crystallisation period was at a late stage in the consolidation of the rock.

121. EULYTINE *(Silicate of Bismuth).*

A very rare mineral, occurring in minute globular patches, of a yellow to brown colour, with a resinous lustre It was identified by the late Professor Ulrich.

Locality: Hampshire Silver Mine (W. R. Bell).

122. EVANSITE *(Hydrated Phosphate of Aluminium).*

A rare species, occurring as botryoidal incrustations which are often almost colourless, but sometimes milky-white, at all times having an attractive pearly lustre. The examples were obtained in a silver-lead lode with galena and sphalerite.

Analysis of this mineral from Zeehan, by Mr. H. G. Smith (Pro. Roy. Soc., N.S.W., 1895):—

		Per cent.
P_2O_5	=	18·11
Al_2O_3	=	40·19
H_2O	=	41·27
		99·57

This mineral also occurs at several localities at Dundas.

123. EXCHERITE *(Basic Calcium, Aluminium, and Iron Silicate).*

This variety of epidote appears to be somewhat abundant on the Upper Emu River, opposite the north-west shoulder of Valentine's Peak. The crystals are at times quite half an inch in length, but are commonly broken and decomposed. Flakes of molybdenite sometimes occur disseminated in the masses of the substances. It is associated with massive white wollastonite.

124. FAHLUNITE *(Hydromica).*

Several forms of the hydro-mica group occur at Mt. Bischoff, the Hampshire Hills, Mt. Lyell, and elsewhere. The identification of the species is at the best doubtful in almost all the members of this very unsatisfactory group. The Bischoff samples are soft, compact, and grey in colour; that from the Hampshire is much darker, almost black in colour, with a shining surface.

125. FAYALITE *(Iron Olivine)*.

This variety of the common olivine is abundant as microscopic crystals, which are of a bright-red colour by transmitted light, in the fayalite-melilite basalt which occurs as an extensive sheet at the Alexandria Battery, near Hobart.

126. FELSPAR GROUP *(Polysilicates of Aluminium, Potassium, &c.)*.

The principal scientific interest attached to this group is the fact that they are the most important of all rock-forming minerals. The classification of the greater number of igneous rocks depends upon the species of felspar forming the essential constituents of the mass. The rock-forming members of the group are found for the most part only in microscopic crystals or portions of the same, but orthoclase often occurs of considerable size individually and in large masses. In pegmatite dykes they assume comparatively gigantic proportions. They are all brittle, have a conchoidal fracture, with ready cleavage in certain directions; hardness about 6. They decompose to kaolin. They may roughly be divided into two large crystallographic divisions, viz., the monoclinic or orthoclastic and the triclinic or plagioclastic. In composition they are silicates of aluminium with either potassium, sodium, or calcium, and rarely barium. Magnesium and iron are never present. They are always of pale shades of colour—from white and translucent to yellowish, red, or green. The specific gravity ranges from 2·5 to 2·9. The felspars are classified first as regards form and next as regards composition. The monoclinic comprise orthoclase, potash felspar; soda orthoclase, potassium-sodium felspar, and hyalophane-barium felspar. The triclinic species include microcline and anorthoclase, potassium-soda felspars; albite, sodium felspar; anorthite, calcium felspar; celsian, barium felspar; as well as the intermediate sodium-calcium or calcium-sodium felspars, oligoclase, andesine

The following are the more important species of the group as occurring in this island, viz.:—

Orthoclase occurs in our granites, syenites, elvans, and quartz porphyries. The most common combinations are (010), (110), (001). Carlsbad twins [twinning plane parallel to the orthopinacoid] (100) are frequently seen. The crystals are generally turbid from decomposition into kaolin, or muscovite. Replacement by pinite, chlorite, &c., has occasionally taken place. Porphyritic crystals of an inch or two in length are common in the granite of the East and North-East Coasts.

Sanidine.—This pellucid monoclinic felspar is found in the alkali syenites and elaeolite syenite porphyries of Port Cygnet. It frequently shows zonal structure.

Plagioclase Felspars, albite, oligoclase, andesine, labradorite, bytownite, anorthite, form a continuous series, in which, according to Tschermak, albite and anorthite are opposite extremes. The intermediate felspars have been shown by Schuster to be isomorphous mixtures of albite and anorthite.

Albite occurs as replacement of the groundmass of porphyroids or keratophyres at Mt. Read; in larger crystals in the actinolitised slates in the North Dundas district. Intergrown with orthoclase, it forms microperthite; seen in granite at Anderson's Creek and in alkali syenite at Port Cygnet.

Labradorite is the felspar of our basalt and dolerite (diabase). Labradorite-bytownite and bytownite-anorthite felspars characterise the gabbros at the Heazlewood, Bald Hill, &c.

Oligoclase, with its narrow twin lamellæ, is the plagioclastic felspar of our granites. Andesine occurs in essexite at Port Cygnet.

Microcline, though chemically identical with orthoclase, is triclinic in crystallisation. Basal sections microscopically show a characteristic cross-hatched twinning, due to the intersection nearly at right angles of the twin lamellæ of two types (albite and pericline). Seen in granite porphyry at St. Marys, and in granite elsewhere.

Analysis of the flesh-coloured veins in the garnet rock which occurs so abundantly at the Shepherd and Murphy Mine, Bell Mount:—

		Per cent.
"Silica	=	56·5
Alumina	=	17·4
Peroxide of iron	=	4·7
Lime	=	5·6
Magnesia	=	0·7
Potash	=	12·0
Soda	=	1·1
Loss at red heat	=	2·0
		100·0

The rock fuses before the blow-pipe, bubbling slightly, and forming a somewhat blebby white mass. It appears to consist mainly of felspar." (F. W. Ward, Government Analyst.)

127. FRANKLINITE *(Oxides of Iron, Manganese, and Zinc).*

A mineral with metallic lustre, dark—almost black—colour, and characteristic reddish-brown streak. Obtained in amorphous and crystalline bunches intermixed with galena, mainly at the 200-feet level, Silver Queen Mine, Zeehan.

128. FREIBERGITE *(Argentiferous Tetrahedrite).*

Silver 'fahl' ore is usually of a much darker colour than the normal substance, and is, moreover, more liable to decomposition. At the Hercules Mine comparatively small pockets of this ore have been met with, which sometimes assayed up to nearly 3000 oz. of silver per ton, and at several of the Dundas fahl ore mines it has been obtained assaying high in silver contents, notably at the Ring Valley and Curtin-Davis Mines.

129. GAHNITE *(Aluminate of Zinc).*

Also known as zinc spinel. Occurs as small octahedra, of a pale-green colour, imbedded in a soft kaolinic matrix, at Mt. Bischoff.

130. FLUORITE *(Fluoride of Calcium).*

This is also known under the names of fluor, fluorspar, and to the Cornish miners as "cann." It crystallises in the isometric system, and is commonly in extremely well-defined cubes of perfect regularity. Fluor is so generally considered a fairly constant associate, and to be intimately connected with the occurrence, of cassiterite, as a tin-carrying fluoric companion, that the comparative rarity of the mineral at the majority of the tin-mining districts of the island is very noticeable. Many of the so-called tin-bearing lodes are totally destitute of the mineral, and its presence in a pronounced form is exceptional. It is almost unknown at the silver-lead mines, and is, in fact, of somewhat rare occurrence under any conditions. Since fluorine is believed to be an important factor in the formation of tinstone as a carrier of the metal, it is remarkable how limited is the occurrence of this mineral throughout the island. It perhaps shows more diversity and variation in colouration than any other known mineral, varying from perfectly water-clear to many shades of green and purple, and even that of a distinct pink tint is not unknown. Colourless fluor when clear and pellucid is a rarity, and is of considerable intrinsic value for the manufacture of microscopic objectives, which when used in conjunction with Jena glass are known as apochromatic. Where plentiful it is used as a fluxing agent in metallurgical work, and is employed in the manufacture of a milky glass, as well as in the production of hydrofluoric acid and various fluorine compounds. The phosphorescence of fluor is a well-known phenomenon, and this property is strongly exemplified in that obtained at Hampshire, and also in that from Mt. Bischoff. The minerals from these localities belong to the variety which has been named chlorophane. Both afford a clear bright pale-green when their powder is strongly heated. Under the influences of radium fragments of mineral from both localities instantly glow intensely with a pale-green light. Well-developed crystals are not infrequent at the Mt. Bischoff Tin Mine. They are up to 1 inch in size, of light amethystine colour, and are accompanied by siderite, quartz, pycnite, and (more rarely) apatite. The crystals are generally octahedra, modified by small faces of the cube. It is also obtained in similar crystals, but mostly of light-greenish colour, in the amphibolite of Mt. Ramsay, associated with scheelite and native bismuth. At the Mt. Black Mine, near Rosebery, the fluor is abundant in a narrow lode with chalcopyrite, pyrite, wolframite, and tourmaline. It illustrates many varieties of colour, from almost white to shades of purple and green, the purple predominating. Some remarkably fine specimens of this mineral have been obtained at the Great Republic and other mines situated at Ben Lomond. The crystals are individually small, but beautifully defined, well and clearly cut cubes. They are from almost colourless to pale-purple, with the apices of the acute angles distinctly stained an intensely dark purple. Modifications of form and intergrowths are not uncommon. This is at once the most attractive and interesting occurrence in this island. At the Thomas' Blocks Silver-lead Mine on the south bank of the Murchison River much fluorite occurs in the lode, intermixed with the prevailing quartz gangue; siderite is also present, but in a subordinate degree, which is unusual in the silver-lead mines as occurring in this State. The country-rock is slate, more or less indurated by interpolated schists; but the lode minerals indicate that acidic intrusive rocks are not far distant. The fluorite is usually in fairly large masses and crystalline. Good crystallisations have been observed; in colour the common tints are a pale shade of bluish-green to almost colourless. It is not unlikely that clear pellucid material may be found if a lookout is kept for such. Occurs at the Oonah Mine, Zeehan, with pyrites and stannite; it is always more or less associated with quartz. The other known occurrences of this mineral are purely of a minor character, and do not call for any special remarks.

131. GALENITE *(Sulphide of Lead).*

This mineral—the most abundant ore of lead—is widely distributed over the northern and western portions of the island, occurring in all its many variations of structure, from the steel-grained to the coarse cubical ore, often exhibiting extreme variation in this respect in the same district, or even in the same mine. In geological occurrence it also varies to a greater extent than almost any other mineral. Here it is common to the tin-bearing granites of Ben Lomond; to the fossiliferous Silurian slates and sandstones of the Zeehan field; as well as occurring in the dolomitised rocks of the Heazlewood and Magnet; and is even found to a limited extent in the auriferous quartz reefs of the Mathinna, Lefroy, and other districts. From nearly all localities the lead sulphide, as occurring in this State, is characterised by the unusually high assay returns of silver that it yields. As is usually the case in lead-producing countries, the common ore of lead is the sulphide. It crystallises in the cubic system, but the occurrence of crystals in this island is quite exceptional. It admits of remarkably perfect cleavage, readily breaking into cubes.

Among the minerals bearing paragenetic relationship occurring here are ferrous-carbonate, blende, and pyrites. Except in rare instances, what are known as the "sparry" accompaniments of the Old World lead-mining localities. such as fluorite and calcite, are usually absent. Galena readily suffers decomposition or alteration near the exposed surface, due to the action of oxygen and carbonic acid, owing to which anglesite, cerussite, and other secondary lead salts are produced by chemical reactions. In rare instances the gradual change from the crystalline sulphide into lead-carbonate and sulphate-carbonate, or, when antimony is present, into bindheimite, is readily detected, the Comet Mine at Dundas affording excellent illustrations of the latter alteration, where the graduation can be distinctly traced. At times, when such an alteration does take place, a nucleus of unaltered galena may be found, which is perfectly surrounded by either one or other of the secondary derivatives. Galena easily tarnishes, in which case it sometimes shows a brilliantly iridescent surface, exhibiting beautifully striking shades of blue-green and red. This phenomenon is specially noticeable in much of the ore obtained at the Junction and Queen Mines at Zeehan. Cavities occurring within the zone of oxidation often exhibit a marginal coating of unaltered galena, with beautifully developed complex crystals of cerussite in the interior.

The coarsely crystalline ore is generally considered to be poor in silver contents, but this is not always the case, as such an ore may at times contain higher values in silver than the steel-grained material which, among miners, is so universally considered such an acquisition. As a rule lead sulphide is richer in silver from lodes occurring in slate, less so when from granite, and is commonly poor in the desired companion when from limestone.

Many of the silver-lead lodes occurring in the Zeehan mining district exhibit, especially near the walls, an unmistakable graphitic substance, which appears not to have originated from altered organic matter, but rather perhaps from the decomposition of metallic carbides of deep-seated origin under favourable conditions. At the Sylvester Mine, Zeehan, a large quantity of beautiful dark-green pyromorphite, with lesser quantity of cerussite, overcapped the lead ore. Native silver, often in arborescent patches, has been frequently obtained attached to the galena, notably at several of the Zeehan mines; and at the Murchison, at Farrell, and at the Godkin Mine, Whyte River. At the Comet Mine, Dundas, an extensive body of argentiferous carbonate lead-ore has been worked; it formed a capping to the primary lead ore. The ferro-manganese lode-capping, or gossan, of the Adelaide and the West Comet Mines in the same locality have become somewhat celebrated for the wonderfully fine masses of crocoisite which they have afforded. The unusual association of magnetite with galena occurs at the Kynance Mine at Zeehan. At the Farrell Mine, at Tullah, a remarkable pipe of galena has been worked, which in portion showed a quantity of greenish lithomarge surrounding and throughout which occurred a considerable number of finely-developed galena crystals, varying in size from very diminutive to about 1 inch in length. They represent mainly cubo-octahedra and perfect octahedra; many single with excellent terminations, while others are irregularly bunched together. They may be said to represent the finest discovery of its nature that has occurred in this island. At the White Hawk Mine, east of Mt. Farrell, the lead ore is associated with milk-white calcite, and is unusually poor in silver. At the Thomas' Blocks Mine, south of Murchison River, quite an unusual quantity of fluorite occurs, which indicates the proximity of the mine to the granite of the region. The spar is remarkably pale in colour, in some instances almost, if not quite, white. The associated gangue is quartz, with less siderite than is usual. The characteristic gangue or lode-matrix of the silver-lead mines throughout the island is a compact form of siderite or carbonate of iron, which is occasionally varied by a small quantity of quartz and rhodocrosite. At the Magnet Silver Mine somewhat fine pseudomorphs of the mineral under consideration after sphalerite, have occasionally occurred. They are usually in irregular groupings, with drusy surface and glimmering lustre. The occurrence of galenite at this mine is of special interest, since it illustrates what is to all appearance a deep-seated lode; as is shown by the laminated arrangement of the seams of ore on either side of a central crustification. At the Rex Hill Tin Mine the surface workings contained a considerable quantity of galena, associated with blende and chalcopyrite.

The antimonial minerals zinkenite and jamesonite are common associates, as is instanced by the comparative abundance of the former at the Magnet Mine, and the latter at the Madame Melba, Spray, Comet, and other mines. At the Stirling Valley a coarse cubical variety occurs, associated with pyrite, which is in crystalline masses. It occurs near Deloraine with barite and dolomite, in laminated bands, alternating with sphalerite. In the auriferous districts of Beaconsfield, Lefroy, and Mathinna galena is of common occurrence in the quartz reefs, intermixed with arsenopyrite, sphalerite and pyrite, and more rarely with stibnite. At the abandoned mines at the Penguin it occurred with nickel and cobalt minerals.

The geological age of the Zeehan and adjacent Dundas silver-lead regions is Cambro-Ordovician to Middle Silurian. The prevailing rock is an argillitic slate, with sandstone, which in places contains numerous testacean fossils. It is bounded on the west by serpentine and the stanniferous granite of Heemskirk, on the north-east by similar rocks, and on the east and south-east by the older rocks of the Read district. The lodes, which are very numerous, appear generally to be true fissure veins, with a prevailing strike west of north. The argentiferous material may be crudely divided into three vertical zones, but without defined bands of demarcation, the upper or surface portion mainly consisting of a lithomargic or clay-like body, usually much seamed with iron oxide. This is known to be of very limited extent, but occasionally contains high values in silver, which is mostly in the form of chorobromide (embolite) or filiform masses of the native metal. The second, or middle, zone is apparently enriched to some degree, and extends to an undefined depth, from the surface, of several hundreds of feet. This portion of the metalliferous lode comprises the highly argentiferous galena for which the field in question is celebrated. At still greater depth much of the sulphide ore appears to give place to siderite, which is the prevailing gangue mineral of the district. In portions of the Zeehan field a light-coloured melaphyre, locally known by the miners as "white rock," occurs, which is at times distinctly interstratified with the ordinary slate rock. It is stated, by those having an extended experience of this mining locality, that when the lodes occur in connection with this igneous rock the ore has a much higher silver content. This interbedded, and perhaps occasionally intrusive, melaphyre has been described in detail by Mr. W. H. Twelvetrees (*vide* Pro. Roy. Soc. Tas., 1896). It is an altered vesicular basalt, or otherwise a basic lava. It is in a varied state of alteration, and is embedded with the slates of the district, which have been allocated to the base of the Middle Silurian epoch. The melaphyre apparently follows the stratification of the slates. In colour the igneous rock is a light-grey, somewhat mottled with a darker shade. It contains numerous macroscopic and microscopic steam pores or cavities, now filled or partly filled in numerous instances with delessite and calcite, or sometimes with both. Siderite is also plentiful throughout the base, and calcite also occurs in the form of thin veins. These minerals are presumably an impregnation after consolidation, and are responsible for the pale colour of the rock.

The complex sulphide ores of the Mt. Read and Rosebery districts in their geological, and to some extent their mineralogical, features present a marked contrast to those which occur at the adjacent mining fields of Zeehan on the one hand and Mt. Farrell on the other, and although differing in their metal and economic production, the salient points generally have a marked similarity, and afford a parallel to the occurrences at Mt. Lyell. Moreover, the same felsitic igneous intrusions are common to both, these being a pronounced characteristic along the line from Lyell on the south to the northern flanks of Mt. Read, and thence some distance further north. This felsite has been described by Mr. W. H. Twelvetrees and the writer (Pro. Roy. Soc. Tas., May, 1899). In this paper reference is made to the relationship of this extensive igneous mass. An endeavour is therein made to show that, so far as known, the igneous intrusive does not contain any appreciable metallic sulphides, and that as soon as this rock is intersected in the various mining workings, the characteristic ores of the locality at once disappear.

The mixed sulphides consist, as a rule, of a fine granular mixture of galena, sphalerite, and pyrite, with a small infusion of chalcopyrite, the whole giving varying assay returns for gold and silver. Occasionally fair-sized masses of highly cubical galena are met with, as well as patches of sphalerite. It is characteristic of the Hercules Mine at Mt. Read that some so-called lodes, or lenticles, may be in parts unusually rich in either lead, zinc, or copper, and again in places the gold is much higher than the normal occurrence. The same remarks apply in a modified degree to the other occurrences on the Mt. Read field as well as at Rosebery. These mixed sulphides form lenticular masses, often with an irregular outline, in the argillaceous and other schists and phyllites usually parallel with the planes of foliation. The lenses of ore have probably been produced by a molecular process of chemical replacement, originating from circulating thermal solutions, which followed lines of weakness throughout the rock. The segregation and disposition of the metallic sulphides were doubtless subsequent to the marked foliation of the ore-bearing rocks. It has been shown by mining operations that as the ends of the metallic lens become too small to be remunerative a crosscut at the extremity may often intersect the starting-point of another mass. These lenses vary in size from a mere thread, in many cases following the foldings of the encasing rock, and imperceptibly dying out, through substantial seams a few inches in thickness, thence to huge masses of great size, which are practically solid mixed sulphides without any noticeable included rock or gangue. These intermixed masses of mixed ore are not peculiar to this island, but are known to occur in many mining regions, notably in France and other places in Europe, America, in Anglesea in Wales, and in Leinster in Ireland. That in Anglesea is reported to have been of large dimensions, and was locally known as "bluestone." The intimate mixture occurring in Ireland has been termed "an argentiferous galenitic-blende," and has been named kilmacooite. It generally contains, however, not only lead and zinc as sulphide, but also, subordinately and in variable proportion, sulphides of iron, copper and antimony with silver, and thus is an exact counterpart of the Tasmanian ores. It has been stated that large quantities of this ore were raised from the Kilmacoo lode in the Connary Mine ("On an Argentiferous Gallenitic Blende at Avoca," by C. R. C. Tichborne, LL.D., Pro. Roy. Soc. Dublin, Vol. IV., 1885).

The earliest recorded discovery of galenite in this island was apparently one of an unimportant nature made at Norfolk Plains in 1851 (Pro. Roy. Soc. Tas., 1851), and it was many years afterwards that practical mining for silver-lead commenced. The first was at the Penguin, about 1870, which was followed by the Bischoff Silver-Lead Company in 1876, and about 1880 mining operations of a similar nature were commenced at the Scamander River. Assays from the mixed argentiferous minerals obtained in the mine at the last locality gave variable returns up to as high as 200 oz. of silver per ton, and a bulk test of about 50 tons produced at the rate of 32 oz. to the ton, with a fair proportion of lead. In the authorised Catalogue of the International Exhibition, Tasmanian Section, 1851, the item "Galena" occurs, reported by Dr. J. Milligan as occurring in mountain limestone at Franklin River. The more important discovery of the existence of galenite at Mt. Zeehan on the West Coast was made by Frank Long on the 8th of December, 1882 (Tilley, "The Wild West of Tasmania," 1891), but mining for this mineral did not commence until about five years later.

The principal localities for the occurrence of galenite are:—Zeehan; Dundas; Ben Lomond; Bischoff; Mt. Claude; Dove River; Heazlewood; Mt. Lyell; Mt. Black; Mt. Tyndall; Mt. Pelion; Penguin; Forth; Henty River; Lake Dora; Mt. Read; Dial Range; Mt. Farrell; Magnet.

132. GARNET GROUP *(Silicate of Various Bases).*

This group includes a considerable number of species with a constant crystallographic habit, belonging to the cubic system. They occur in rhombic dodecahedra, cositetrahedra, as well as sometimes massive and granular. The lustre is vitreous to resinous. Colour varies from almost white through brown, red, green, yellow to black. They may be transparent to opaque, with great variation in this respect. When the colours are rich and free from flaws they are looked upon as gems of minor value. Garnets are abundant in many mica, hornblende, and chloritic schists, occurring often in granite, syenite, crystalline limestone, and (more rarely) in serpentine. They are a product of contact metamorphism, more particularly in the zone connecting limestone and the crystalline rocks. Small pink garnets occur numerously scattered throughout a dark-green chlorite, which is rich in cassiterite, with some blende and copper pyrites. This chlorite occurs as a band connected with the granite.

Locality: Stony Ford, about a mile from George's Bay, East Coast.

"Yellow crystals (grossularite?) occur at Mayne's Tin Mine, south of Mt. Heemskirk. The forms developed are the trapezohedron, or a combination of this form with the rhombic dodecahedron. Similar crystals are found in the ore-body of the old Silver Stream Mine at the Comstock, usually in combination with lime-bearing silicates. The garnet also forms a gangue mineral in the sphalerite ore of this mine. Clear blood-red crystals also are found at Mayne's Tin Mine." (L. K. Ward.)

Undetermined species occur at the Hampshire Hills, where they are found in profusion. They vary from brown to black in colour, and often reach an inch in diameter. On the south side of Cape Barren Island they exist *in situ* in a quartz porphyry, also free in the detritus derived therefrom, usually mixed with cassiterite. At several localities in the north-eastern tinfields they are plentiful in the drift, but generally of small size; common in the vicinity of Mt. Heemskirk, usually opaque, but sometimes of good colour and transparent. Near Mt. Claude a solid compact to sub-crystalline garnet rock of yellowish-brown colour occurs, apparently belonging to the sub-species grossularite. At Mt. Ramsay another rockmass has been found of a dark-brown colour. At this locality well-formed crystals have been obtained, embedded in a soft magma that allows them to be easily extracted. Near Highwood, on the Emu River, clearly-cut dodecahedra, of a translucent white to light-yellow colour, occur in lode-matter (W. R. Bell); and on the Whyte River, near the Meredith Range, in minute crystals and compact masses of reddish-yellow colour—apparently belonging to the variety essonite—with actinolite and molybdenite as accessory minerals.

See also ALMANDITE, APLOME, GROSSULARITE, JOHNSTONOTITE, MELANITE.

133. GENTHITE *(Hydrated Silicate of Nickel and Magnesium).*

A few small specimens of this nickel gymnite, showing the characteristic apple-green colouration, have been obtained from the workings of the Heazlewood Silver-lead mines. They occurred as a thin incrustation on the dolomite veinstone of the lodes. It has also been found sparingly on the pentlandite which occurs in the vicinity of Mt. Agnew.

134. GIBBSITE *(Aluminium Hydrate).*

This is found as a white incrusting mineral, with an obscure fibrous structure. It also occurs in small coralloidal aggregations, mamillary patches and prisms, implanted on limonite and manganese minerals, at the Central Dundas, West Comet, and other mines at Dundas. Plentiful as an incrustation, accompanied by native copper and earthy matter, at the Rio Tinto Mine, Savage River. At this locality it varies in colour from clear pellucid to a pale-green, and (more rarely) to golden-yellow with a bronze lustre. It forms a thin seam on the wall of a copper lode at the Burnie Copper Mine, Blythe River. This mineral is also known under the name of hydrargillite.

135. GILBERTITE *(Altered Potash Mica).*

A common result of the alteration of muscovite is the formation of gilbertite; this is especially noticeable in the stanniferous granites and porphyries. It might correctly be termed a hydrated muscovite, and thus comes near the substance which has been named margarodite. It varies in colour from yellow to a pale-greenish, and has a glimmering lustre. At the Shepherd and Murphy Mine, Bell Mount, it often contains embedded crystals of cassiterite and, at times, wolframite. It abounds at most of the tin mines in the Ben Lomond and Blue Tier districts.

136. GLAUBER SALT *(Sulphate of Sodium).*

Occurs on the floor and walls of caves and shelving saliferous rocks as an efflorescent coating, and is commonly intermixed with other sulphates and earthy matter. It is monoclinic in crystallisation, the primary form being an oblique rhombic prism; but crystals are a rarity. Occurs at the Alum Cliff, River Mersey; near Chudleigh; in an old adit at the abandoned slate quarry, Back Creek, and other favourable places.

137. GLAUCODOTE *(Sulpharsenide of Iron and Cobalt).*

Crystallises in the orthorhombic system. It is in reality a cobaltic variety of arsenopyrite, with which it closely agrees in crystal habit. Samples of this mineral have been obtained at North-East Dundas which gave on assay 20 per cent. of Co.

138. GOETHITE *(Hydrated Peroxide of Iron).*

This is a good mineral species, crystallising in the rhombic system. It may be known from other iron minerals by its blood-red colour when seen by transmitted light, and brownish-yellow streak. It is often globular and stalactitic in habit, and but rarely in crystals. It occurs sparingly, as a coating, at the Magnet Mine; more abundant at the Dial Range; Blythe River, with hematite; and some rather nice specimens have been obtained at the Penguin. It occurs at Dundas in the ferro-manganese gossan cappings of the silver-lead lodes, and in smaller quantity at several other localities.

139. GOLD.

The early history of the discovery of gold in Tasmania is involved in obscurity by the unreasonable reports of the occurrence of the precious metal in unlikely localities, but it is beyond doubt that its existence was known as far back as between the years 1840 and 1845, small quantities having been obtained in the George Town district, near the present Lefroy and Beaconsfield goldfields, on either side of the River Tamar. Towards the end of 1851 many persons returned to the island with experience of alluvial gold-mining gained in Victoria, and apparently some of these began prospecting in the Fingal district. It would appear that the first payable discovery was made early in 1852, on the estate of Mr. James Grant at Tullochgorum, near Fingal, the locality becoming known as Golden Valley.

Gold is obtained as alluvial, in quartz reefs, and as an accessory in copper-silver mining, as at the Lyell district; with complex lead-zinc sulphides, as at Mt. Read and the Rosebery districts; with silver-lead, as at the Devon and other mines of like character; and with alluvial tin ore, as at various places in the north-east mining districts.

The auriferous drifts are of late Tertiary age, and some of the fields have produced large quantities of the precious metal, notably the Lisle field, which is reputed to have produced from 10 to 15 tons of gold. The basin of the King River, vicinity of the Pieman River, Long Plain, Lefroy, Beaconsfield, Bell Mount, and Mathinna have each produced large quantities in the past.

The average purity of Tasmanian gold is about 96 per cent., the balance being the metals of the platinoid groups. The two largest nuggets obtained were discovered at the Rocky River, a tributary of the Pieman, in 1883. Their respective weights were 143 and 243 oz. Auriferous quartz reefs have been discovered in almost all portions of the island where the older Palæozoic formations occur. The strata are presumed to be the Lower Silurian (Ordovician) epoch, but those of the Queen River and Middlesex districts may be of Upper Silurian age. The prevailing rocks are slate and sandstone, except in the Golconda district, where the auriferous reefs apparently exist in the intrusive granite which has pierced the sedimentary rocks of the locality.

A few peculiar features as to the paragenesis of gold and other local peculiarities may be interesting and worthy of record. At the Campbell's Reward Mine, near Mt. Claude, a few miles below the bridge at Lorinna, the precious metal occurred in a very small vein or fracture plane in a rock that has been termed porphyritic syenite; the gold was faced on to the rock with a backing of decomposed felspar, and occurred in fern-like arborescent patches occasionally altering to radiating masses, the whole presenting a very peculiar and unique appearance. Much of the separated metal had the appearance of irregularly chopped hair, each fragment as seen under the microscope being covered with extremely minute recurved barbs. Scattered throughout the mass were also flakey plates of extreme tenuity, the surface of these being covered with subcrystalline reticulated impressions. The general structure of the metal and its mode of occurrence differ very much from any other auriferous formation known to exist in the island. The Long Plain alluvial goldfield was noted for the numerous and remarkably fine crystal groups of the metal that were obtained. Many individual crystals were found measuring more than ¼-inch in length, and they were often aggregated in masses of considerable size; sometimes presenting an exquisitely beautiful arboriform structure, and others again in a filiform mass, the latter occasionally so intermixed as to present a sponge-like structure. It is to be regretted that more examples of these peculiar masses were not secured as museum specimens, for now their occurrence has almost become a matter of history. The gold, was, as a rule, but little waterworn, and apparently originally occurred in small lenticular veins composed of siderite, quartz, and pyrites, interlaminated in the folia of the schistose country-rock. In some of the Lefroy mines very fine examples of "slickensides" occur, which are often faced with striations and patches of gold, the whole being furrowed and highly polished. At the Queen River an almost white gold has been obtained, caused by its admixture with silver, and thus forming the variety known as electrum. At McKusick's Creek, near the King River, a considerable number of crystals were obtained, the prevailing form being much elongated, in many instances reaching nearly an inch in length. On the property of the Union Prospecting Association, at Back Creek, the metal has been discovered scattered throughout a matrix of white friable sandstone, which apparently forms the wall of a quartz reef, and at Middlesex it has occurred in a similar rock. At Mt. Ramsay the cupriferous pyrites, occurring in the characteristic hornblendic rock of the locality, has been found by analysis to be highly auriferous. At Mt. Lyell the ironstone, principally micaceous hematite and limonite, contains more or less free gold, which is also the case with the pyrites and native copper occurring at the same locality. At the Specimen Reef Mine and other places near the Savage River a large quantity of gold has been obtained in and closely associated with siderite, which mineral appears to be the main matrix of the metal at this locality. At Lefroy and in the Fingal district when galena is met with in the mines it often contains gold, and the small quantity of sphalerite that occurs is invariably auriferous. At Waterhouse and vicinity a considerable quantity of auriferous mispickel and marcasite occurs in the quartz reefs of the district, and the greater portion of the various pyritous minerals of the Beaconsfield, Lefroy, and Fingal gold-mining districts are so rich in the precious metal as to make their metallurgical treatment of considerable importance to the various mines.

At Middlesex gold has been found associated with carbonate of bismuth, a peculiarity not known to exist at any other locality in the island. In the vicinity of the Pieman River district the auriferous drifts often contain a comparatively large quantity of osmiridium—Badger Plain, near the Savage River, being a noted locality. In the stanniferous drift near Branxholm small flakes of gold are often met with, but not in sufficient quantity to render it of any economic importance. Much of the alluvial gold obtained on the Lisle field is often coated with a dark, almost black, substance, which is apparently ferro-manganese. Gold occurs sparingly in a soft siliceous tufa of a yellowish-brown colour, in a body of considerable extent in connection with an igneous rock at the Castray River. In the same formation grains of iridium are often met with, and numerous fine grains of titaniferous iron. At Mt. Stourmont, about 4 miles from Black Bluff, Middlesex, a peculiar filiform variety of gold has been obtained in small seams traversing a siliceous rock.

At the Tasmania Mine, Beaconsfield, various metallic minerals occur disseminated throughout the quartz reef, including tetrahedrite, chalcopyrite, arsenopyrite, and pyrite. The gangue also contains a large quantity of the carbonates of magnesia, lime, and iron, probably in the form of dolomite, siderite, and calcite. At the Lisle alluvial field small specks of gold have been detected in the blocks of the solid sandstone which occurs in and about the auriferous detritus. At the Black Bluff, Middlesex, gold has been discovered embedded in micaceous hematite. Some very rich specimens have been exhibited from this locality. The gangue is apparently a rubbly quartz. A thin seam of greenish-coloured batchelorite, extremely rich in gold, has been mined on the footwall of cupriferous pyrites at the Mt. Lyell Mine. At the Hercules Mine, Mt. Read, zinciferous lead ores, rich in both gold and silver, have been exported for metallurgical treatment.

Regarding the occurrence of gold in the Mt. Lyell Company's workings, Mr. R. Sticht kindly supplies the following note:—"The Mt. Lyell ore-body as a whole has been getting lower and lower in gold contents with the depth of the workings, but to our astonishment we found a local enrichment in gold a few months ago, which is unique enough perhaps to be mentioned when referring to the subject of gold in the Catalogue. The occurrence is in the ordinary mine run of Mt. Lyell pyrites, as enriched by fahl-ore. On the whole the conjunction of gold and fahl-ore is somewhat rare and unusual. The assay was as follows:—

Cu = 7·97 per cent.
Ag = 24·22 ozs. per ton
Au = 6·78 ozs. per ton

An assay of another piece, taken from the same spot, is as follows:—

Cu = 8·4 per cent.
Ag = 24·0 ozs. per ton
Au = 6·8 ozs. per ton

The locality is the footwall of the Mt. Lyell ore-body, in No. 7 level, which is 500 feet below the surface of the outcrop of the ore-body."

In addition to the common occurrence of gold with quartz, pyrite, and arsenopyrite, it has also been found in Tasmania in association with the following minerals, viz.:—

Batchelorite.—Mt. Lyell.

Bornite.—Mt. Lyell.

Bismutite.—Middlesex.

Cassiterite.—Branxholm.

Chalcopyrite.—Mt. Lyell; Rosebery Mine, North-east Dundas; Mt. Read district.

Chromite (as minute crystals).—Castray River.

Cupriferous Pyrite.—Mt. Ramsay; Mt. Lyell; Rosebery, North-East Dundas; Hercules, and other mines at Mt. Read; Rio Tinto, Savage River; Scamander River.

Galenite.—Zeehan; Mathinna; Devon Mine, Middlesex.

Hematite (Micaceous).—Black Bluff, Middlesex; Mt. Lyell.

Huascolite.—Hercules Mine, Mt. Read.

Limonite.—Mt. Read; Mt. Lyell; North-East Dundas.

Native Copper.—Mt. Lyell.

Osmiridium.—Pieman River district; Blue Tier, near Beaconsfield; Castray River.

Pyrrhotite.—Beaconsfield.

Rutile.—Lymington, Port Cygnet.

Sandstone.—Glenn Prospecting Association, Middlesex.

Siderite.—Specimen Reef, Savage River.

Sphalerite.—Mt. Read; North-East Dundas.

Stannite.—Silver Queen Mine, Zeehan.

Titaniferous Iron Sand (Iscrine).—Pieman district; Lisle Goldfield; and other places.

140. GOSLARITE *(Hydrous Sulphate of Zinc).*

This vitriol occurs as small mammillary and investing bunches, which are usually stained with iron oxide, in the dry workings of the older mines. It may be detected by its characteristic astringent and nauseous taste. It occurred in some abundance, intermixed with other sulphates, in an adit at the Blue Tier, near Beaconsfield; and also at the Comstock Mine, near Zeehan.

141 GRAPHITE *(Plumbago, Carbon).*

Of common occurrence as graphitic slate, of no commercial importance. At the silver-lead mines of Zeehan and Dundas it often occurs in the walls of the lodes more or less intermixed with earthy matter, and more rarely in the cleavages of the ore. In the vicinity of the Ring River a small seam occurs a few inches in thickness. At the North Valley at Bischoff a somewhat loose mass occurred with a high metallic lustre. On the beach about 2 miles west of the Leven River it is abundant in the form of graphitic schist. It coats the joints of a crystalline limestone at the Wilmot River. It is reported to occur in considerable quantity, but of indifferent quality, at Cape Barren Island; and at the Rocky River Mine.

142. GROSSULARITE *(Calcium-Aluminium Garnet).*

This mineral occurs as a subcrystallised to a somewhat compact rock of a pale olive-green to brown colour, and rather vitreous lustre, near Mt. Claude. What seems to be this species of garnet occurs abundantly in the massive form at the Shepherd and Murphy Mine, Bell Mount, Middlesex. It is of a peculiar yellowish-green colour, very compact and tough, with a vitreous-oily lustre. It often affects an irregular undefined banded habit, and is almost invariably closely intermixed and parallel with an intensely black finely granular magnetite. Both the garnet and the magnetite are traversed by narrow bands of a pink to salmon-coloured wollastonite, and the magnetite may contain minute specks of pyrites scattered plentifully throughout its substance. At Mayne's Tin Mine, Mt. Heemskirk, this variety of garnet occurs as a narrow seam with closely packed characteristic crystals of a bright-yellowish brown colour. The crystals are very minute, but often well formed. (L. K. Ward).

143. GUITERMANITE *(Sulphide of Arsenic and Lead).*

A massive mineral occurs in the No. 1 south workings of the Magnet Mine, which has much the physical appearance of the above, and agrees with it as regards colour and hardness; but it is extremely difficult, if not impossible, to isolate the pure material; and the same applies to the original guitermanite from Colorado. It is provisionally placed under that species. It is bluish gray in colour, with an obscure metallic lustre, always intimately mixed with galena, sphalerite, and sometimes zinkenite. Upon being struck it emits a strong odour of garlic.

144. GYPSUM *(Sulphate of Calcium, or Selenite).*

This is not an abundant mineral as occurring in this island. It is found at the Grunter Hill, Upper Mersey River, as veins, occurring in blue limestone, and as radiating masses of considerable size, which have an iridescent tarnish. It is also in limited quantity at Circular Pond Marsh, near Gad's Hill. At Trial Harbour and some other localities a small quantity has been noticed, while in fractures in the dolerite rock at Launceston. minute crystals occur rather plentifully. At Trefoil Island, off Cape Grim, small irregular specimens, clear and translucent, have been obtained.

145. HALITE *(Chloride of Sodium).*

It would appear that some portion of the Mesozoic sandstone as exposed in the midland districts is constantly saliferous, so much so that a restricted area is the source of a permanent and apparently inexhaustible supply of chloride of sodium, or common salt. It has been collected in a limited quantity for a lengthy period, and is locally used for domestic purposes. No wholly, or even partially, solid bed of salt has been discovered in this or any other portion of the island. It is therefore highly probable that the repeated renewal of the supply is derived from the surrounding rocks, which are presumably saliferous. The source of the mineral is a series of small lagoons or lakelets, which contain saline water, or what are known locally as the "salt pans." These are situated approximately between Tunbridge on the south, and Ross on the north, and comprise portions of the following estates, viz.:—Lowe's Park, Ballochmyle, Ellenthorpe, and Mona Vale. The so-called "pans" are at least ten in number, and are in area from 1 to 100 acres. They extend in a south-east by north-west course for a distance of about 7 miles, and it is remarkable that on either side of this strike, although in close proximity, other small lagoons occur which are devoid of any appreciable quality. This may be owing to the non-saline lakelets having outlets, by which overflow the probable original saline contents are exhausted. The most prolific "pans" in the mineral are those situated on the Ballochmyle and Mona Vale estates, which in favourable dry seasons have been known to yield many tons of salt. The surface of the "pans" is during the dry season coated with an efflorescence of the salt, by the evaporation of the water, to a depth often as much as 2 inches in thickness. This has been scraped up for domestic use, and the lower or contaminated portion used for manure. The supply is apparently renewed without any reported diminution in quantity year by year, as evidenced by the fact that quite recently some at least of the "pans" were observed to be coated with the white incrustation of the salt. It has been stated that this salt was formerly a source of wealth to the now extinct aboriginals, who laid claim to the surrounding lands, and the vicinity was often the scene of hotly contested battle and bloodshed. (Pro. Roy. Soc. Tas., 1889, pp. XXII.-XXIII.).

146. HALLOYSITE *(Hydrated Silicate of Aluminium).*

This extremely unsatisfactory substance is presumed to contain more silica than kaolin and more aluminium than smectite, but there may be an indefinite variation from one to the other. When it contains an admixture of iron oxide it varies to a substance that is known as bole. It occurs at numerous localities.

147. HALOTRICHITE *(Hydrous Sulphate of Iron and Aluminium).*

This iron alum occurs at several localities as an efflorescence or as small stalactitic growths in old mine workings. It also forms fibrous silky masses, which are commonly stained with iron oxide. It has been found at Alberton, Mt. Heemskirk and other places

148. HAUYNITE *(Orthosilicate of Sodium, Calcium, and Aluminium, with some Sulphate of Sodium.)*

This is a rare alkaline accessory rock-forming mineral which is usually associated with such minerals as nephelite and leucite. In crystallisation it is cubical, and its habit affects the rhombic dodecahedron, but it is generally in micro-crystalline grains, or may be massive. The pure unaltered substance is commonly some shade of bluish-green or pale-blue, and is translucent. It occurs sparingly as micro-crystals in the fayalite-melilite basalt of One Tree Point, near Hobart, and pseudomorphed to limonite in the haüyne-trachyte of Port Cygnet.

149. HEMATITE *(Peroxide of Iron).*

The native ferric oxide, which is so widely known as hematite, usually occurs massive in this island, and is almost unknown in a well-crystallised form. It is at once one of the most abundant and widely diffused minerals occurring in the northern and north-western portions of the State. It crystallises in the rhombohedral system. The crystals are usually in the form known as "specular iron." They have almost invariably a highly splendent lustre, which characteristic is strongly noticeable with much of the flakey material occurring in association with the massive ore at the Penguin, and in a more limited degree as regards quantity with that associated with wollastonite near Rocky Cape (N.W. Coast), where it is in irregular crystalline scales superimposed upon each other. The same applies to other occurrences, from which habit originates the universal application of the term "micaceous iron ore." In occurrence hematite is commonly associated with the hydrated oxides göethite and limonite. These species usually form portions of the surface-outcrop, which at times passes, by the admixture of alumina or magnesia, into a soft ochre. It may sometimes be derived from the hydrates by the removal of water, but the opposite alteration by the hydration of the red-ore is in all probability much more frequent. When occurring in quantity its usual habit is in irregular deposits, often in the planes of sedimentary rock bedding. It is at times more or less siliceous; crystals of quartz are not infrequently closely intermixed, and occasionally line the interior of cavities, or are gathered together in patches or bunches. The views which have been advanced from time to time to explain the origin and distribution of this substance are varied to a degree. The origin of the ore itself is one thing, and the origin of the deposit another; so that, singly or combined, there is presented a subject which affords argument for a variety of hypotheses. Doubtless each separate locality affords local peculiarities which are characteristic of itself, and would lend support to a given line of argument. It is the opinion of many authorities, confirmed by local observation, that in a vast number of cases the hematite masses have originated by the substitution of iron, which has in other words been replaced by metasomatic action. Pseudomorphs of various minerals to this ore are not by any means rare, and organisms such as certain mollusca and corals are occasionally so altered. Such examples offer emphatic evidence in favour of the replacement theory, which may have been carried on in favourable rock-masses, which were likewise suitably located. On the other hand, ferruginous matter may, under certain conditions, by precipitation and percolation have occupied vughs or cavities in the rocks, and after consolidation may have been exposed by denudation. It has been stated that the intrusion of acid rocks, such as the granites, has been a primary factor in many occurrences, and there is evidence to show that this assumption is not without reason. At the Blythe River an enormous mass, which boldly outcrops on the banks of the stream, is well known. It has been estimated to contain many millions of tons, a calculation which is confirmed by the prospecting operations which have been carried out. It is a hard massive ore of a bluish purple colour, which gives the normal reddish-brown powder. Throughout small cavities occur, which are occasionally lined with minute crystals. It is reported to be well adapted for the manufacture of pig-iron, and to be remarkably free from deleterious substances.

An average sample over the whole deposit gives the following complete analysis:—

Ferric oxide	86·954	63·259 per cent. iron
Ferrous oxide	3·074	
Silica	7·312	per cent.
Alumina	1·756	"
Lime	0·068	"
Magnesia	0·071	"
Sulphur trioxide	0·060	per cent., 0·024 per cent. sulphur
Phosphorus pentoxide	0·083	per cent., 0·036 per cent. phosphorus
Titanic acid	0·03	per cent.
Copper	Trace	
Arsenic	Trace	
Manganese	Trace	
Chromium	Absent	
Combined water	0·324	per cent.
Moisture	0·160	"
	99·892	

("Report from the Royal Commission on "The Bonuses for Manufactures Bill," The Parliament of the Commonwealth of Australia, 1904.)

At Ilfracombe, near the west bank of the Tamar Heads, there occurs a vast quantity of hematite in association with other ores of iron. Attempts have been made to treat this economically, but the pig-iron resulting was reported to contain an appreciable quantity of chrome, which at the time was considered detrimental to its commercial use. From the Penguin River a considerable tonnage has been mined and exported to other States for fluxing and other purposes, and the same applies in a lesser degree to the deposits on the banks of the Tamar River. At Zeehan it occurs pseudomorphous after cubical pyrites. The other somewhat numerous occurrences of hematite in this State do not call for special mention, as, generally speaking the mineral as known here does not present features of serious concern to the mineralogist, notwithstanding its obvious interest geologically and commercially. Almost all the many forms it assumes have been obtained in greater or less profusion; these may be divided into four principal groups, viz.:--

(1) *Specular Iron*—the crystallised form.

" Hepatic form in well-defined crystals in the south end of Flinders Island, on the beach in basalt, south-west of Mt. Eliza " (Gould, Pro Roy. Soc. Tas., 1871); Forth River; Black Bluff Mountain; Arthur River, near the Hellyer; Dial Range, with manganese oxide; Mt. Lyell; Ilfracombe; Blythe, Leven, Forth, and Penguin Rivers; Meredith Range: at Ilfracombe a variety occurs which is termed " needle ore "—the crystals are often of considerable size and much intermixed.

(2) *Massive, or Red Hematite.*

Forth River, near its junction with the Dove; it is foliated, and has a highly brilliant lustre; it occurs in a quartz-porphyry and covers a considerable area; at the Blythe an enormous mass occurs in practically an inexhaustible quantity and very good quality; on the west bank of the Tamar extensive deposits exist which have been economically worked; Circular Head; Blue Tier; Mt. Heemskirk; King River; Fieman River; Flinders Island;

Arthur River; Dial Range; Mt. Lyell; Red Hills; Mts. Owen, Jukes, and Darwin; and many other places.

(3) *Micaceous.*

Of minute scaly structure. White River, in quartz; Mt. Read; Macquarie Harbour; Pieman River; Dundas; Mt. Heemskirk; Mt. Lyell, where it is in part highly auriferous. At this locality a variety occurs in minute crystals, forming a black powder, which is reported to be also auriferous; assays have been made up to 15 ozs. of gold per ton of material; at the Black Bluff, Middlesex, it occurs highly auriferous. Common in the schist regions of west and south-west Tasmania.

(4) *Reddle.*—Red ochre or earthy oxide.

This variety commonly occurs with the other forms from which it is disintegrated; it is often impure by admixture with earthy matter. Occurs in considerable abundance at many places on the West Tamar and along the north-west portion of the island; Flinders Island; Mt. Lyell, where it is often intimately mixed with powdery barite, in which state it has been termed "volcanic mud"; and "crocus"; at this locality it often contains free gold.

It has been stated ("Tasmania and its Mineral Resources, 1888") that "early in the century Lieut.-Governor Collins forwarded a quantity of the ore to England, but without practical results, though Mr. Commissioner Bigge subsequently stated in his report on the trade and agriculture of New South Wales (of which this colony was then a dependency) that analysis made in England proved it 'to consist of pure protoxide of iron, similar to the black ore of Sweden, and furnishing a very pure and malleable metal.'" Surveyor-General Evans states ("A Geographical, Historical, and Topographical Description of Van Diemen's Land, 1822"): "Within a few miles of Launceston there is a most surprising abundance of iron. Literally speaking, there are entire mountains of the ore, which is so remarkably rich that it has been found to yield 70 per cent. of pure metal."

150. Hercynite *(Iron Aluminate).*

Iron spinel occurs in fairly large lumps in tin drifts. It is amorphous, dull, of a bluish-black colour, and fine granular.

Analysis by Mr. J. D. Millen:—

		Per cent.
$Fe_2 O_3$	=	46·91
$Cu O$	=	·005
$Si O$	=	·0892
$Ca O$	=	·086
$Cr_2 O_3$	=	·049
$Al_2 O_3$	=	41·69
		99·37

Locality: Near Moorina.

151. Hisingerite *(Hydrated Ferric Silicate).*

In amorphous masses of an intensely black colour, with a conchoidal fracture. In lode-matter exposed in the lower tunnel of the Comstock Mine, Comstock district.

152. Histrixite *(Sulphide of Antimony and Bismuth).*

A new mineral occurring in radiating groups of prismatic crystals, which are occasionally in confused bunches, and commonly stained externally with a dark brown coating. The crystals are orthorhombic, with acute but indistinct terminations, and striated longitudinally. They sometimes reach over 2 inches in length by ⅜-inch in width. Slightly sectile, with a hardness of about 2. Lustre eminently metallic, shining on fresh crystalline surfaces; colour and streak steel-gray. When massive it presents a foliated structure, and tarnishes to blue and purple iridescent colouration. The crystals occurred interpenetrating a vugh from a bedding of a mixture of iron and copper pyrites. It was found in a somewhat massive body of tetrahedrite, with which were associated bismuthinite and pyrites, and appeared to be of very exceptional occurrence.

Results of two analyses of the pure material:—

	Per cent.		Per cent.
S =	24·05	S =	23·01
Bi =	55·93	Bi =	56·08
Sb =	10·08	Sb =	9·33
Cu =	6·86	Cu =	6·12
Fe =	5·18	Fe =	5·44
	102·10		99·98

Answering to the formula—

$$7Bi_2 S_3 + Sb_2 S_3 + 5Cu Fe S_2$$

Locality: No. 1, Curtin-Davis Mine, Ringville.

This mineral occurs massive at several of the North-East Dundas mines, where it is classed under the common designation of "fahl-ore," a term applied to several distinct minerals with the general physical characters of tetrahedrite.

153. Huascolite *(Sulphide of Lead and Zinc).*

In the fine granular galena-blende ore-bodies which are so characteristic of the Hercules-Read mines, a substance occurs, which is apparently homogeneous, and fairly corresponds with the double sulphide huascolite. It has a massive granular structure, is lead-gray in colour, with a lustre rather duller than ordinary galena. It occurs closely intermixed with the fine particles of galena and blende, but can be separated. If the metals are chemically combined, it will to a great extent account for the utter impossibility of mechanically separating the lead and zinc contents of these ore-bodies. A substance of similar character has been obtained at the Comstock Mine, Zeehan, and at the Godkin Extended, Whyte River. The mineral as mined at the Hercules Mine contains approximately 35 per cent. Zn, 20 per cent. Pb, with a variable quantity of Ag and a little Au. At the Godkin Extended Mine the mineral was obtained associated with blocks of galena and slugs of argentite, the whole affording high assay value in silver.

154. Hyalite *(Hydrated Silica).*

Occurs in cavities of a hard lode gangue in white to pale-green botryoidal masses. Locality: Bell's Reward Mine, Heazlewood. At the Argent Mine, Zeehan, in masses of considerable beauty with opalescent reflections.

155. Hydrocerussite *(Basic Lead Carbonate)*

In one of the adits of the Hercules Mine, Mt. Read, a white fluidal substance was observed in decomposed lode-matter, which on giving up its hygroscopic water, assumed a silvery white appearance, and which under the microscope is resolved into very minute scales, but with little or no hexagonal structure. In all essential respects the substance agrees with this species.

156. Hydromagnesite *(Hydrocarbonate of Magnesium).*

An amorphous mineral resulting from the alteration of brucite. It has not been found in a crystallised condition, its usual mode of occurrence being in the form of chalk-like crusts. In serpentine, with brucite. Locality: Near Mt Agnew. Of apparently rare occurrence, in thin incrustations, Heazlewood; occurs in solid, almost white, radiating bunches at the Comstock Mine, Zeehan.

157. HYPERSTHENE *(Silicate of Magnesia, Calcium, and Iron).*

An orthorhombic pyroxene, related to enstatite, the former being rich in iron, and the latter containing a much smaller amount of that element. On the east side of the Parson's Hood Mountain this mineral occurs with schiller spar and diallage rock. Fairly abundant at the Heazlewood; on the Forth River; Meredith Range; Dundas. "Thin sections of gabbro received from Mr. W. R. Bell as occurring in the Parson's Hood Range show under the microscope crystals of hypersthene more or less converted into bastite." (Ulrich.) In granite, St. Mary's Pass.

158. HYDRONEPHELITE *(Hydrous Silicate of Sodium and Aluminium).*

This zeolite commonly occurs as a white massive mass, usually having a strongly perceptible radiating structure; it also affects a tufted habit when occurring in cavities or vughs.

It has been detected in the elæolite syenite of Port Cygnet, and at the Shannon Tier. It is remarkably abundant in the nephelinite of the latter locality. In some instances the mineral occurs in rather large patches, which are snow-white, and thus strongly contrast with the intensely black augite and grey base of the rock.

159. IDOCRASE *(Basic Silicate of Calcium and Aluminium).*

Also known as vesuvianite. This species is a member of the tetragonal system. The general form of the crystals is a rectangular prism, terminated by planes, with the edges of the prism sometimes replaced. The facets are highly polished. It occurs at the Hampshire, near the old silver mine, often massive, closely intermixed with brown garnet, with patches of highly-coloured amethystine quartz, and thus forming attractive specimens; about a mile north-west of the Shepherd and Murphy Mine, at Middlesex, it occurs associated with much magnetite; sparingly found at Anderson's Creek, near Beaconsfield.

160. IODYRITE *(Iodide of Silver).*

This rare ore of silver crystallises in the hexagonal system, with a hemimorphic habit. The colour is pale yellow. It has been reported to occur in small quantity at what was known as the Washington Hay Silver Mine, Heazlewood.

161. IRON, METEORIC *(Iron, Nickel, &c.)*.

This element is only known to occur in this State in the meteoric form, of which three occurrences have been recorded, viz.:—

1. The Blue Tier Siderite.—This is a comparatively small meteorite, weighing but 3 lb., which was found at the Blue Tier, East Coast. (Catalogue of Tasmanian Minerals, 1893.)

2. The Castray Siderite.—A diminutive specimen, weighing only 51 gr., that was obtained by a miner in 1899, with two others of similar size, when ground-sluicing auriferous drift on the banks of the Castray River, a tributary of the Heazlewood River. (Pro. Roy. Soc. Tas., 1900.)

3. The Lefroy Siderite.—This is a still smaller specimen, whose weight is but 3·328 grains. It was found by a prospector in testing a dish of alluvial drift for gold at Lefroy in 1904. (Pro. Roy. Soc. Tas., 1905.)

162. ISERINE *(Titaniferous Iron Sand)*.

Abundant in many localities; Pieman River; south of Macquarie Harbour; Beaconsfield; Lisle goldfield.

163. IVAARITE *(Silicotitanate of Calcium and Iron)*.

This is a very dark-coloured and garnet-like mineral, which is of complex composition, but rich in titanic acid. It is normally, when in a fresh undecomposed condition, of high lustre, intensely black, and quite opaque. It is an extremely rare mineral in nature, and is apparently restricted to the elæolite rocks. In this State it occurs in the form of small crystals, which are commonly in a high state of decomposition to a brownish-coloured substance, and are irregularly scattered in considerable numbers throughout the elæolite-syenite porphyry of Port Cygnet.

164. JAMESONITE *(Sulphantimonite of Lead)*.

Occurs in somewhat large quantity at the Silver Cliff and the old Waratah mines at Mt. Bischoff. At this locality its common mode of occurrence is filiform and amorphous, the entangled fibres often forming large masses of a dark, almost black colour. At the Madame Melba Mine at Dundas it was discovered forming a dense compact lode, the fractures of which contained bands and coatings of the mixed oxides of antimony and lead. At this locality it occasionally forms bunches of fine acicular crystals which are implanted upon brown spar, and it is not uncommonly intermixed with boulangerite and galena.

At Zeehan a considerable quantity of this mineral closely resembles schultzite. In colour and streak it is lead-grey; lustre dull, metallic, and silky; very brittle, with a subconchoidal fracture; hardness, 2·5; specific gravity, mean of five examples tested, 5·98. On coal it is very fusible, depositing white antimonial sublimate. It is found in masses, often with blende, intermixed with galena, in various mines at Zeehan.

Analysis of a sample from the Magnet Mine:—

Ag = 0·12 per cent. = 39 oz. 4 dwt. 10 gr. per ton.
Pb = 40·82
As = 2·44
Sb = 21·48
Fe = 4·91
S = 17·51
Insol = 11·51

98·85

Analysis of a sample from the Silver Spray Mine, Zeehan, by W. F. Ward, Government Analyst:—

Per cent.
Pb = 40
Sb = 29
S = 18

87

Analysis of a columnar and striated sample from Mt. Bischoff:—

Per cent.
Ag = 0·12
Pb = 32·08
As = trace
Sb = 26·74
Fe = 5· 6
S = 17·82
SiO_2 = 14·28
Al = trace

96·60

165. Johnstonotite *(Manganese Garnet).*

This presumably new manganese garnet was named and described by Messrs. Macleod and White in the proceedings of the Royal Society of Tasmania, 1898-99. It occurs abundantly distributed in the mica-sölvsbergite of Port Cygnet. It is of a brownish-yellow tint, in crystals, sometimes over a quarter of an inch in diameter, and shows well-developed trapezoidal faces.

The cavities containing the garnet are often lined with a coating of purple fluorite, and a small quantity of arsenopyrite is usually present in addition. Pseudomorphs of marcasite after johnstonotite are occasionally to be found in the rock.

Under the microscope zonal banding is observable, and in many cases aegirine-augite is enclosed.

The following is the analysis, viz.: —

Per cent.
$Si\ O_2$ = 36·87
$Al\ O_3$ = 7·28
$Fe\ O$ = 17·12
$Mg\ O$ = 12·49
$Ca\ O$ = 11·98
$Mn\ O$ = 13·68
Ignition loss = ·29

99·71

166. Kammererite. (See Stichite.)

167. Kaolinite *(Hydrated Silicate of Aluminium).*

The ordinary porcelain clay or kaolin which, when pure, does not contain any alkaline substance, and should not fuse on extreme heating. The major portion of the numerous clays termed kaolin are more or less fusible, and therefore impure, if not misnamed. The mineral is the result of the alteration of felspars which have undergone extreme change through the probable action of hydrofluoric emanations from profound depths. It has been noted that there is a constant and conspicuous presence of fluorine-bearing minerals, notably fluorite, throughout the China clay districts of Cornwall, England. The true kaolinite has superficially extremely local distribution, but considerable downward extension, and it is supposed that it may represent pipes up which fluoric and boracic vapours escaped ("Summary of Progress of Geological Survey for 1901-1902," p. 26). The superficial alteration or kaolinisation of felspar still admits of application in numerous occurrences, which action may be through the circulation of meteoric waters containing carbonic acid. Kaolinite is known to occur at Killikrankie Bay, Flinders Island; Middlesex; Mt. Housetop; Derby; near George's Bay and near Alford, Lower Piper River.

168. Kerosene Shale.

This is a substance which has been described as neither shale nor cannel coal, but rather as an intermediate variety between the shale-cannel group and bituminous coal, and further, it would probably produce benzines rather than oils. It occurs as seams in the sandstones and clay-slates belonging to the lower coal measures of the Permo-Carboniferous epoch in the parish of Preolenna, which is situated between the Jessie and Flowerdale Rivers, and is thus about 16 miles south of the seaport of Wynyard, near Table Cape, North-West Coast.

The shale and coalfield covers an approximate known area of about 2 miles by 1 mile, and the shale itself has been exposed at two points. One of the seams is 20 inches in thickness, and is composed of 6 inches of the kerosene shale in question, with 14 inches of bright and splint (?) coal. The shale is black. has a decided pitchy lustre, strongly marked conchoidal fracture, and is remarkably tough and somewhat sectile. As fragments of the shale have been observed at various points, mostly in the beds of the streams, it is highly probable that it covers a larger area than has been exposed. It may also be noted that for many years past samples of the shale have been obtained on the coast mainly in the vicinity of the Inglis River; these have probably been washed downstream for a considerable distance, or they may represent an extension of the Permo-Carboniferous area to nearer the coast. An analagous mineral from New South Wales has received the name of woollongonite, but this is a misnomer, as it is not known to occur at the locality indicated by the term. It differs so much from the ordinary torbanite, dysodile, and cannel that it would seem a specific appellation is desirable unless the term kerosene shale may be deemed sufficient.

Samples tested at the Tasmanian Government laboratories yielded the following results, viz.:—

	Fixed Carbon.	Gases, &c.	Ash.	Moisture.
No. 1......	21·0	76·2	2·3	0·5
No. 2......	23·2	71·6	4·1	1·1

Samples have also been analysed in the laboratories of the New South Wales Government, with the following results, viz.:—

	Fixed Carbon.	Gases, &c.	Ash.	Moisture.
No. 3......	28·51	67·32	2·92	1·25

(See "Report on Kerosene Shale and Coal Seams in the Parish of Preolenna," by W. H. Twelvetrees, 1903.)

The pelionite of Barn Bluff is a somewhat similar material, but it has not been discovered *in situ*; it is only known as loose surface fragments of varying size. Mr. W. A. Dixon, F.I.C., of Sydney, New South Wales, states:—"Coal of this quality should be of value for gas-making, but it will be of little use for oil-making, as it would yield more tar than oils, which would be difficult to purify. I am satisfied from its appearance, and behaviour when subjected to heat, that it would give rather aromatic hydrocarbons (benzine, napthalin, &c.) than fatty ones (olefines and paraffin). It is not a cannel (from which oils are not made) and not a shale (from which they are made). I would be inclined to name the mineral 'pitch coal,' as being most expressive of its appearance."

Average of analyses made by Messrs. Dixon, Ward, Sharp, and Newberry gave the following results, viz.:—

Fixed Carbon.	Gases, &c.	Ash.	Sulphur.	Water.
42·4	52·8	4·3	0·7	0·2

169. KILMARCOOITE. (See GALENA.)

170. KNOXVILLITE *(Sulphate of Chromium, Iron, and Aluminium).*

Occurs as a granular sugar-like substance of a pale-green colour. From adit at the Victoria Gold Mine, Salisbury.

Analysis: —

		Per cent.
SO_3	=	30·32
Cr_2O_3	=	8·47
Al_2O_3	=	2·48
Fe_2O_3	=	15·86
Loss on ignition	=	40·56
		97·59

The identification is somewhat doubtful.

171. KERMESITE *(Oxysulphide of Antimony).*

Occurs in attached tufts of radiating capillary crystals, which are usually of a shade of red. It has been obtained in extremely limited quantity implanted in the fractures of jamesonite at the British Zeehan Mine, Zeehan.

172. KYANITE *(Silicate of Aluminium).*

Occurs crystallised in long oblique four-sided prisms, irregularly terminated. Colour usually very pale-blue, commonly translucent, but may be transparent. Occurs in characteristic pale-blue prisms near Mt. Cameron; also near Hamilton-on-Forth; Clayton Rivulet (Gould, Pro. Roy. Soc. Tas., 1873).

173. LABRADORITE *(Polysilicate of Aluminium, Sodium, and Calcium).*

The common rock-forming triclinic felspar which is the essential constituent in all basalts and dolerites. It is only known to occur in this island in its micro rock-forming character.

174. LAUMONTITE *(Hydrated Silicate of Aluminium and Calcium).*

A monoclinic zeolite of extremely decomposable nature. It is flesh-red in colour, but soon fades on exposure. It occurs in the cavities of a metamorphic rock which abuts on to the granite, and forms druses in the hornblendic veinstone at the Hampshire Silver Mine. The crystals show only the unit prism with a steep orthodome. Occurs of a pink colour in lode-fissures at the Shepherd and Murphy Mine, Middlesex.

175. LEAD, Native.

In its native state this metal is of extreme rarity. Two small specimens were obtained at a mine which was known as the South Nevada at Dundas many years ago, and more recently an example was procured from the gossan outcrop at the Comet Mine, Dundas.

176. LEADHILLITE *(Sulphocarbonate of Lead).*

This mineral crystallises in the monoclinic system with the common habit of a right-rhombic prism. It is characterised by its pearly lustre on the cleavage face, grey to yellow colour, and chemical reactions. At the Victoria Magnet Mine, Whyte River, it has been met with in the form of somewhat large amorphous masses, which rarely have minute crystals attached. They occurred embedded in a soft clay-like matrix, associated with earthy pyromorphite and cerussite. It has occurred rarely at several of the Dundas silver-lead mines, and at the Magnet it has been found attached to the interior of small vughs in the gossan capping the ore-body.

177. LEPIDOLITE *(Basic Fluosilicate of Potassium, Lithium, and Aluminium).*

Commonly known as lithia mica. It usually forms coarse granular masses of flexible scales, which are translucent and of a purplish colour, varying to silver-white. It occurs as a narrow vein or dyke between metamorphic slate and an igneous rock at Mt. Ramsay.

178. LEPIDOMELANE *(Silicate of Iron, Aluminium, and Potassium).*

A dark-coloured variety of mica, occurring in granite, usually found at the contact of the plutonic and sedimentary rocks.

Occurs at Mt. Heemskirk. Occurs in large six-sided tables, occasionally 1 inch in breadth, of a black colour, and highly adamantine. Transparent in very thin laminæ, showing a beautiful emerald-green colour. The crystals for the species are remarkably fine, and well-developed. They are found aggregated in association with a peculiar amphibole and quartz, and evidently form portion of a contact rock on the fringe of granite.

Locality: Hampshire, near the old silver mine.

179. LEUCOCHALCITE *(Arsenate of Copper).*

A small quantity of this substance was obtained as a fine fibrous coating of a milk-white colour with axinite and chalcopyrite at the Colebrook, North-East Dundas.

180. LEUCHTENBERGITE *(Basic Silicate of Magnesium and Aluminium).*

A chlorite poor in iron, and thus pale in colour. Only detected microscopically in the variolite rock at the Magnet Mine.

181. LEUCOPYRITE *(Arsenate of Iron).*

White arsenical pyrites is not so abundant as arsenopyrite, but it is by no means a rare species.

At North-East Dundas it is occasionally met with, and at the Colebrook Mine it is the prevailing arsenical iron ore, occurring in irregular patches in the interstices of and disseminated throughout the axinite-bearing rocks. At various mines in the North-East Dundas district this species occurs in more or less quantity.

182. LILLIANITE *(Sulphobismutite of Lead).*

Found disseminated in association with bismuth sulphide and other minerals in a quartz matrix at the Osborn Blocks, Mt. Farrell.

This is an extremely unusual mineral, which was named after the Lillian Mine, near Leadville, Colorado; it is also recorded as occurring in Sweden. As found in this State it is highly argentiferous, often assaying several hundreds of ounces of silver to the ton of ore.

183. LIGNITE *(Brown Coal).*

A semi-formed coal, retaining the texture of the wood from which it was formed. Bischoff; Breadalbane; Evandale; Macquarie Harbour; Launceston; Young Town; Pig Island; and other places.

At Beaconsfield a peculiar variety is found, which appears to be close to a form that has been named dopplerite. It is an extremely brittle, intensely black, highly polished, jet-like hydro-carbonaceous substance that has been obtained from the Tasmania and other gold mines at Beaconsfield. It occurs at considerable depth from the surface in the workings of the mines, which are in Silurian strata, and apparently originates from infiltrated water charged with organic matter. A mineral with much the same appearance and nature has been found in the Bischoff Silver-lead Mine; it occurred filling cleavage planes and in vughs in the lode gangue. At the Upper Arthur River, about 3 miles from Bischoff, a similar substance occurs in a hard siliceous rock, again filling cavities.

184. LITHOMARGE *(Hydrated Silicate of Aluminium).*

A soft, unctuous, clay-like substance, more or less coloured by iron oxide. In common with similar substances, an unsatisfactory mineral.

Near Conara; Piper River; Mt. Claude; Flinders Island; Mt. Bischoff. Abundant at Mt. Lyell, often containing native copper; Blue Tier, near Beaconsfield; often met with on the north-east tinfields, where it apparently results from the decomposition of felspars of the granite.

185 MAGNESITE *(Carbonate of Magnesium).*

Occurs in serpentine, Parson's Hood Mountain; in veins, Trial Harbour; Meredith Range; Dundas; Heazlewood.

This mineral has only been detected in comparatively limited quantity, although usually not by any means a rare species under favourable conditions. It is always massive, and often contaminated with earthy matter. The pure material is milk-white, and of a close, compact texture. When free from silica and lime it is of considerable commercial importance.

186. MARGARITE *(Hydrated Silicate of Aluminium and Calcium).*

This substance belongs to the class of basic brittle micas which form a transition from the micas proper, or those mineral species which are characterised by their distinctly elastic laminæ, and the chlorites, which latter are commonly foliated or show a granular aggregate of scales, and which are, moreover, usually coloured green by ferrous iron. Margarite or calcium mica crystallises in the monoclinic system, but is rarely in distinct crystals; it usually occurs in aggregates of pearly subtranslucent scales of pale tints. It is an alteration product, which is not rarely a common ingredient in the geologically older schistose rocks. It occurs in the schists of the Lyell-Read districts, which are presumed to be mainly of igneous origin. Professor J. W. Gregory remarks:—"The rocks of the Mt. Lyell schists are, moreover, very poor in lime; accordingly they cannot include any considerable amount of the lime-mica, margarite" ("The Mount Lyell Mining Field," Aus. In. Min. En., 1905.) The indefinite substance which has been termed margarodite is also referred to in the same report as forming the base of the Lyell schists, and may be regarded as composed of a very fine-grained intermixture of paragonite (white soda mica) and one of the varieties of damourite (white potash mica), with occasional inclusions of margarite. "These minerals are not always present in a crystalline form, but the crystalline patches pass off imperceptibly into crypto-crystalline and granular material. The material has no doubt been formed from the decomposition of an alkali felspar, from which most or all of the alkalies have been leached away" (*loc. cit.*).

187. LIMONITE *(Hydrated Peroxide of Iron).*

This is not what may be termed a good species, as it never occurs in distinct crystals. The streak is always yellow, by which it may be known from hematite and magnetite. It often forms a cementing medium of breccias and conglomerates. At Dundas is occurs pseudomorphous after siderite, and is then known locally as "tomahawk iron." On the banks of the River Tamar extinct Tertiary species of fresh-water bivalves belonging to the genus Unio are occasionally obtained, similarly changed to limonite. At Beaconsfield, at the eastern tinfields, and at the Savage River crystals of pyrites have been found altered in the same manner. It is abundant at the Heazlewood, Meredith Range, Savage River, Ilfracombe, Beaconsfield, Blythe, Dial Range, Mt. Claude, Middlesex, Housetop, Mt. Lyell, King River, Mt. Ramsay, Mt. Read, Magnet, Bischoff, Dundas, Zeehan, and many other localities. Much of the material usually termed gossan on all the mining fields in this State. in common with what prevails in most mineral-producing centres, is limonite. In mineral veins carrying the unstable pyrites, chalybite, or other iron-bearing minerals, it is usual to find the capping or upper portion of the mass consisting of much brown oxide of iron, more or less contaminated, or otherwise gossan. This alteration is created by oxidising agencies. This characteristic is almost invariable in regard to copper-bearing ore-bodies, or any lode containing pyrites in any form, and in this State is a prevailing feature of our larger metallic veins. Sometimes the rusty material is in connection with quartz as gangue, and then the latter is generally honeycombed, due to the loss of the original pyrite. The presumed connection between the outcrop and the ore which may exist below is expressed by the old adage—

> "A lode that wears no iron hat
> Is never likely to be fat."

The ferric hydrate or limonite occupies naturally only the superficial portion of the lode or vein, or above the water-level of the country below which the primary sulphide of the metals may be expected to occur with little alteration. Enormous masses of this substance have been worked at many of the mines occurring in this State, notably at the West Comet, Hercules, and Magnet. At the Hercules much of the gossan contained payable quantities of both gold and silver. A limited quantity was exceedingly rich—up to as high as 20 oz. of Au with 3 to 400 oz. of Ag. At the lastmentioned mine many thousands of tons have been mined, containing high values in both lead and silver, the former in the form of disseminated oxide and carbonate, and the latter mainly in the form of minute particles and crystals of chloro-bromide or analagous minerals. Sometimes it happens that the agencies of oxidisation affect the lodemass to considerable depths, as has occurred at the Magnet Mine, where the gossan has been mined at a depth of over 500 feet, but the decomposed ore is in diminishing length as level succeeds level. This is probably the greatest depth to which the gossan is known to occur in this State; but in the well-known Dalcoath Mine, Cornwall, England, the oxidised products have been found to a depth of 197 fathoms (Collins, Journal R. Inst. Cornwall, Vol. IX., p. 471).

Regarding the associated secondary minerals, it has been shown that metallic sulphides exposed to the influence of water free from carbonates are usually converted to sulphates, but the presence of carbonates determines the formation of oxides, hydrates, and carbonates, the chromic, vanadic, and other acids obtained from the minerals of the adjacent rocks or the lode constituents also affecting those which are formed in the material resulting from the alteration of the original lode and contents. The gossan generally bears a relation to the normal ore-body, but it does not always follow that a rich outcrop will cover a correspondingly rich material below the zone of oxidation. The gossan outcrop of silver-lead or copper lodes is of great interest to the mineralogist, as it is from this that he secures many of the most beautiful minerals occurring in nature, both as regards attractive colouration and crystallisation. It is in this laboratory that the oxysalts have their origin, and form numerous homogeneous chemical combinations known as mineral species. The beautiful chromates, phosphates, arsenates, carbonates, and other secondary minerals are almost confined to the zone of oxidation, and would be practically unknown but for the influence of this, Nature's alchemist.

Limonite has the property in a high degree of agglutinating sand and gravel into concretionary forms, which vary in size from quite minute to masses a foot or more in diameter. Although the shapes assumed are generally very irregular and capricious, they are often more or less rounded, occasionally tubular or box-like. They may show a hollow interior surrounded by a comparatively thin crust, enclosing mud, sand, or a loose stony kernel, in which latter case they may distinctly rattle on being shaken. Such examples are common about Ravenswood and numerous other localities where decomposed effusive rocks have been subjected to the influence of meteoric waters. At the Vale of Belvoir remarkably-shaped worm-like and other fantastic concretionary forms are abundant. In cavernous vughs which are occasionally met with in mines, such as have occurred in the gossanous upper workings of the Hercules Mine, limonite is not infrequently found in stalactitic forms, pointing to its deposition from surface waters. These are sometimes of considerable length, and are not rarely blackened by manganese hydrate. More rarely they are more or less coated with minute crystals of mimetite, and even still more rarely they are ornamented with blebs of dundasite and crystals of cerussite, which scintillate when seen by artificial light. This mineral forms in most part what is commonly known as "bog-iron ore," generally containing more or less manganese; and occasionally a fibrous structure is developed, as is sometimes seen in lode outcrops. What is known as "ochre" is this mineral mixed with aluminous material. In this form it becomes a valuable substance, used as a colouring medium in the manufacture of paint. This iron ochre is fairly abundant in many localities, and is reported to be industrially worked near Carlton. Limonite in irregular elongated cylindrical forms is abundant in the recent clays used for brick manufacture in the vicinity of Launceston. These have been mistaken for fossilised portions of trees, organic remains, and even for reptiles.

At Mt. Lyell blocks of concretionary limonite which are hollow often contain implanted crystals of cuprite. Specimens have been obtained showing exceptionally well-formed crystals of this mineral, which are occasionally of a remarkably large size for the species. At the Dundas Extended, Adelaide, Magnet, and Whyte River silver-lead mines magnificent samples of crocoisite have been obtained penetrating and implanted upon limonite in association with manganese oxides. It may be remarked that chalcophanite, cerussite, gibbsite, and other well-known minerals are commonly similarly connected, which occurrences are referred to under their respective heads. Native copper has been found associated with this mineral at the Rocky River and in the vicinity of Mt. Lyell; and native silver in capillary masses has been collected at several mines at Zeehan, at the Murchison Mine at Mt. Farrell, as well as other finds of a similar nature of less importance. At the celebrated Bischoff mines it forms the major portion of that part of the mine known as the "Brown Face," which was beyond reasonable doubt a huge mass of pyrites containing disseminated cassiterite, and in parts extensive bodies of tourmaline and other minerals. At the Mt. Cleveland Tin Mine large quantities occur also containing finely disseminated tin ore.

Hudlestone has remarked (Pro. Geol. Assn., Vol. XI. 1889, p. 104) that iron in rocks is rendered locomotive by means of carbonic acid, a soluble acid carbonate being formed, and is fixed by means of oxygen, the solution of bicarbonate on exposure to air depositing the hydroxide as a kind of bog-ore.

188. MAGNETITE *(Sesquioxide of Iron).*

Crystallises in the isometric system with a common octahedron habit, but also occurs in dodecahedra; the cubic form is exceedingly rare. The pure mineral contains empirically 28 per cent. of oxygen. It may be recognised by its strong magnetic character, its effect upon the compass, and by its black powder. With menaccanite it forms large quantities of black sand, which results from the disintegration of the crystalline rocks. Microscopically it is always present as a constituent in all dense dark-coloured rocks of the basic type. It apparently separated from the molten magma at an early phase of the consolidation of the rock, and is often found embedded in other constituents. The irruption of granite or other plutonic rocks is supposed to cause, in many cases, a metamorphism to magnetite of other ores or adjacent rock-masses. It may also be the result of the deoxidation of hematite or of contact with effusive rocks. It is supposed that amphibolite often alters this mineral. Martite is presumed to be a pseudomorph after hematite. A remarkably pure, highly magnetic form occurs in large quantity at the Hampshire Hills. It is somewhat granular in structure, and often presents a striking iridescent tarnish. At Meredith Range to the vicinity of the Pieman River it is in great plenty; Ilfracombe, with hematite and other ores of iron; at the Blythe River, near Housetop Mountain; Mt. Pelion; Dundas, near Mt. Black. At the Savage River it shows strong polarity and forms enormous masses associated with pyrites and limonite; plentiful at Mt. Agnew. In the vicinity of Bell Mount, Middlesex, the massive ore is abundant, occasionally in close intermixture with garnet. It also occurs at this locality as beautifully-formed little octahedra, and occasionally dodecahedra, which are really excellent specimens of their kind. At the Tenth Legion, near Zeehan, it is found massive, with occasional vughs, in which large well-formed crystals are not rarely obtained; abundant at South Mt. Darwin. "A massive intensely black and shining magnetite, which shows strong polarity, occurs in connection with the serpentine at the Serpentine Hill, over the Argent tunnel, on the Emu Bay Railway Company's line. It often shows a fibrous structure, which is at times remarkably distinct, and may be dislocated. . . . . In the serpentine of Dundas and North Dundas there is a notable development of fibrous or columnar magnetite in veins throughout the rock. The fibres and columns are usually straight, and stand at right angles to the course of the veins. At times they are strangely contorted into sinuous curves. The magnetite is commonly polar." (L. K. Ward.)

There are less important occurrences of magnetite at several other localities.

189. MALACHITE *(Green Carbonate of Copper).*

This mineral, which is so abundant in several of the mining districts of Australia, is here comparatively rare, and only known to occur in a thin coating or incrustation. Heazlewood; Cascade; Mackintosh River; Badger Head; Frankford, &c. Eastern Proprietary property, Scamander River, in a mammillated form, with pyrite and chalcopyrite.

190. MANGANITE *(Hydrous Manganese Sesquioxide).*

This material crystallises in the orthorhombic system. It occurs in bunches of striated columnar crystals, whch, under favourable conditions, are among the most perfect examples of mineral crystallisation. It also occurs massive and radiating.

As small bunches of well-formed crystals, Hampshire Silver Mine.

191. MARIATITE *(Sulphide of Zinc and Iron).*

This is a variety of blende, portion of the zinc being replaced by iron. It is dark-coloured, almost black, with sub-metallic lustre.

Star of Peace Tin Mine, Cascade; Rex Hill, near Ben Lomond; Mt. Bischoff; and other localities.

192. MARCASITE *(Sulphide of Iron).*

This extremely variable mineral, both as regards composition and habit of occurrence, is also known as "white" iron pyrites. It is practically dimorphous with ordinary pyrite, but is often contaminated with arsenic, which element replaces portion of the sulphur. It crystallises in the orthorhombic system with the primary form of the right rhombic prism, with numerous modifications. It often occurs in reniform and botryoidal masses, and at times assumes a capillary habit. In colour it varies from a pale bronze-yellow to almost tin-white. It readily decomposes, and is the parent of several sulphates of iron. Alterations to limonite, sphalerite, and other minerals are recorded, and pseudomorphs are common. It occurs after wood at Cox's Bight and elsewhere. The rounded concretions of the "orbicular" rock which occurs in the vicinity of the Magnet Mine are at times transmuted to this mineral, while at Beaconsfield Teritary fossil-fruits, met with in the deep auriferous alluvial, are similarly altered. In the stanniferous drift of Cape Barren Island these fossil-fruits have also been found, and are in many instances altered in the same manner. Marcasite is apparently of comparatively recent origin, and is of common occurrence in connection with clay, lignite, and the coal measures.

It often occurs in the Mersey and Don coal measures; at Beaconsfield, Scamander River, and many other localities.

193. MARIALITE *(Hydrous Silicate of Aluminium and Calcium).*

This is a member of the scapolite family. Its mode of crystallisation is in the tetragonal system, but it is commonly in the massive state.

This mineral was obtained as loosened rounded boulders from a vein in a seam of asbestos occurring in the serpentine at Anderson's Creek, near Beaconsfield. It was mistaken by the miners for quartz, which it somewhat resembles. It has, however, a slightly greenish tinge, and its hardness is only between 5 and 6. It is soluble with difficulty in H Cl.

Microscopical characters confusedly crystalline, with the larger crystal faces obscurely divergent. The crystals often form rosettes. Double refraction higher than quartz. Extinction straight in longitudinal sections. No sensible absorption.

Scapolite occurs mostly in metamorphosed rocks, ophites, amphibolites, gneiss, and altered gabbro. At Anderson's Creek its occurrence is probably due to vein-forming processes. It also occurs at the Heazlewood in limited quantity, of a pale-green colour.

194. MARMOLITE *(Foliated Serpentine).*

Serpentines vary to a considerable extent, both in colour and structure. This is the distinctly foliated variety.

Bonanza Mine, Dundas (Montgomery).

195. MASSICOT *(Yellow Lead Oxide).*

Usually occurs as a powdery coating on the sulphide or oxidised lead ores; it is but rarely met with in a massive condition. It is often closely intermixed with the oxides of antimony and iron.

Obtained in comparatively large quantity with galena, cerussite, and anglesite, Comet Mine, Dundas; with ferro-manganese, cerussite, and galenite, but rarely associated with crocoisite, Adelaide Proprietary; incrusting jamesonite and galenite, usually intermixed with antimonial ochre, Madame Melba, North Dundas; in limited quantity at several of the Heazlewood and Zeehan silver-lead mines.

At Dundas this ore gives high assay returns in silver, which metal probably occurs as an intermixed chloride.

196. MATLOCKITE *(Oxychloride of Lead).*

A mineral first discovered at the old mining locality of Matlock, in Derbyshire, England, and hence the name given to it. It crystallises in the tetragonal system, but affects a tabular habit, due to the development of the basal pinacoid, and thus may be distinguished from its congener phosgenite, which has a prismatic habit, although falling into the same crystallographic system. It is often pearly on planes of cleavage, and may be transparent to translucent. It was found in tabular crystals of a greenish-grey colour, apparently rare, associated with mixed sulphide and carbonate ores of lead at the Sylvester Mine, Zeehan; in small patches of a honey-yellow colour attached to galena at the Montana Mine, Zeehan. At the Magnet Mine it is not rare, occurring of the normal form in smallish pale-yellow crystals attached to gossany ferro-manganese, in association with minute crystals of crocoisite and purplish chalcophanite.

197. MELACONITE *(Black Oxide of Copper).*

This mineral is also known as tenorite. Rarely found in quantity; its common mode of occurrence is as a thin coating upon other copper minerals. It is found at several mines at Cascade. At this locality it was met with disseminated and filling small pockets in the granite, often occurring with chalcopyrite and cassiterite; Penguin Copper Mine, with pyrites and gray sulphide of copper; Saxon's Creek, near Frankford, in the clefts of lode quartz, with cupriferous pyrites; in considerable quantity, associated with tile ore and chalcopyrite, Eastern Proprietary Mine, Scamander River; in an old adit, Australasian Slate Quarry, Back Creek; Burnie Copper Mine, Blythe, coating chalcopyrite; Mt. Balfour and Mt. Lyell with other ores of copper.

198. MELANCHROITE *(Basic Chromate of Lead).*

This form of lead chromate differs mainly from crocoisite in its darker colour and brick-red streak.

Judging from the small quantity obtained, it appears to be of rare occurrence. That examined was found on some specimens of ferro-manganese gossan from the Adelaide Proprietary Mine, at Dundas. It occurred in small amorphous patches, mixed with larger masses of its congener and flakes of galena.

Hitherto its only recorded locality has been the silver-lead mines of the Ural, Siberia, so that its detection here is of interest to mineralogists.

199. MELANITE *(Calcium—Iron Garnet).*

As small dodecahedral crystals in the haüyne-trachyte and elæolite-syenite of Port Cygnet. The crystals are occasionally beautifully formed (110), often with splendid zonary structure, as seen in section under the microscope, and in grains.

200. MELANTERITE *(Hydrous Ferrous-sulphate).*

Doubtless originates from the decomposition of pyrites; it is usually found in old mine workings, where there is a slow percolation of water.

In adit level, Mt. Bischoff; Silver Crown Mine, Zeehan; Blue Tier, near Beaconsfield. At the Tasmania Gold Mine, at Beaconsfield, it occurs in considerable quantity in the older workings.

201. MELILITE *(Silicate of Aluminium, Iron, Calcium, Magnesium, and Sodium).*

As microscopic rock-forming crystals in the melilite-basalt of the Shannon Tier, and One Tree Point, near Hobart.

202. MENACCANITE *(Titanic Iron Oxide).*

This, with pleonaste, constitutes the "black jack" of the East Coast tin-miners. It is extremely abundant, its principal localities being the Blue Tier, Cascade, Mt. Claude, Denison, Dundas, Blythe River (blue-black to black); George's Bay, and other places. The variety nigrine is said to occur abundantly at Rocky Point, West Coast.

It occurs fairly abundantly in small, well-formed, and highly modified crystals impregnated in the hornblende rock of the Mt. Ramsay Bismuth Mine.

203. MESOLITE *(Hydrated Silicate of Aluminium, Calcium, and Soda).*

A zeolite occurring as small globules of a fibrous structure.

In basalt, near railway-bridge, Hellyer River; Bell Mount, Middlesex, with other zeolites; Myrtle Bank and other places under like conditions.

204. MICA GROUP.

The various and somewhat numerous species belonging to this important group are all strongly characterised by their basal cleavage, thus yielding easily perfect laminæ of extreme tenuity; or in other words they have a micaceous structure. The laminæ are remarkably tough, and more or less elastic. All the micas have a splendent pearly and metalloid lustre, although they vary in colour to a remarkable extent. All the members of the group resemble each other, their perfect basal cleavage permitting smooth plates to be separated, which are noted for their elasticity. They all belong to the monoclinic system of crystallisation, but they have a pseudo-hexagonal habit, differing from all other monoclinic minerals in the form assumed by the crystals, and by their optical behaviour. The acute bisectrix or first median line is not absolutely normal to the basal plane, although it seldom makes an angle of more than five or six degrees with the direction of cleavage, and frequently one of less than half a degree. For this reason cleavage plates of mica show interference figures under convergent polarised light. The micas are essential and important constituents of many igneous rocks, such as granites, gneisses, schists, and others. In pegmatite veins the crystals and plates are often of large dimensions, even up to several feet in diameter in the mica mines of India, Russia, Canada, and even in Central Australia. Several of the species are of considerable commercial importance, being employed as electrical insulators and for other uses. Lepidolite is the main source of lithium used in the pharmacopœia. In chemical composition they are difficult to classify, as they have a tendency to merge one into the other. They may be conveniently divided into—

(1) Ferro-magnesium mica = biotite.
(2) Alkali mica with potash = muscovite.
,, ,, soda = paragonite.
,, ,, lithia = lepidolite.

That rich in both iron and lithium is termed zinnwaldite, and that containing high magnesia and little iron is termed phlogopite. Muscovite is an essential in many granites and porphyries, but is not contained in effusive lavas. It also occurs in rocks subject to regional metamorphosis. Lepidolite occurs in pegmatite granites usually associated with tourmaline and minerals containing fluorine. Zinnwaldite is invariably present, if not masked by alteration, in the acid tin-bearing rocks. Biotite is found in some granites, and is common to many rocks of volcanic origin, and also to the crystalline schists. Many minor varieties have been named owing to local peculiarities or variation in constituent composition, such as fuchsite (chrome-mica), roscoelite (vanadium mica), alurgite (manganese mica), and many others.

See BIOTITE, LEPIDOLITE, MUSCOVITE, PHLOGOPITE, SERICITE, ZINNWALDITE.

205. MICROCLINE *(Polysilicate of Potassium and Aluminium).*

A triclinic potash felspar occurring abundantly in the hypersthene granite of St. Mary's Pass.

206. MILOSCHINITE *(Hydrous Silicate of Aluminium and Chromic Acid).*

This is also known as chromic ochre. It is a soft claylike pulverulent or earthy mixture, which is coloured various shades of green by chromic acid. It occurs plentifully at the Blue Tier, near Beaconsfield; at Dundas, near Mt. Claude; and at Zeehan.

207. MILLERITE *(Sulphide of Nickel).*

Occurs in the form of delicate brass-like fibres, usually in the fissures of serpentine and other rocks. It may have been introduced into the rock as nickeliferous pyrites. The pure mineral contains approximately 64 per cent. of nickel.

Occurs as capillary filaments near Leslie Junction, Dundas, with pentlandite; in serpentine near the Colebrook. It has been reported to occur with galena and other minerals at the old silver mine at the Penguin. At the Blue Tier, near Beaconsfield, it has been noticed in small quantity.

208. MIMETITE *(Chloroarsenate of Lead).*

This and its congener pyromorphite are not by any means rare species, since they are commonly found in more or less quantity in the upper levels of many lead mines, where they doubtless originate from the decomposition of galena, the alteration of arsenopyrite affording, directly or indirectly, the acid radical to the lead for the mimetite. Isomorphous admixtures, with its ally pyromorphite, are abundant; in fact the one grades into the other imperceptibly, and they have several characteristics in common. They exhibit optical anomalies; the chloro-arsenate is always biaxial, and the chloro-phosphate is uniaxial; in proportion to the degree of admixture of the firstmentioned it changes to the biaxial. Both crystallise in the hexagonal system. At times there may be a pronounced curvature of the prism faces to such a degree as to form almost spherical masses. This variety is known as campylite.

Occurs in minute bunches of crystals on the wall of the lode at the Hampshire Silver Mine; at the Magnet Mine the mineral is often found in well-formed crystals, which are from almost colourless to the normal brown. Occurs at the Britannia and other Zeehan silver-lead mines; at the Hercules in white to dark-brown crystal groups; at North-East Dundas it has been obtained in the usual small crystals, at times fairly plentiful.

Variety—*Chromiferous Mimetite.*

This variety never assumes the barrel-like shape so common to the typical mineral. It is found in short hexagonal prisms and plates, with basal terminations, usually about 1 millimeter in breadth and length. The colour varies from a decided brownish-green to deep orange; it is shining and opaque. The streak is orange to siskin-green. Before the blowpipe in salt of phosphorus it remains green when cold after both flames. In closed tube with splinter of charcoal and heated intensely it gives very strong and characteristic reactions for $As\ O_4$; with cupric oxide gives flame reactions for Cl, and in closed tube with magnesium wire the odour of P^2O_5 It is reduced to metallic lead with soda on coal. This is a variety sufficiently distinct in composition, colour, and habit to be worthy of record. It is rarely met with at its only known locality, and then in comparatively small groups of crystals, but its peculiar colourization, combined with the habit of usually occurring in thin plates, at once arrests attention. The chemical reactions show that it is more allied to mimetite than to pyromorphite, a chromiferous variety of which has been recorded. Locality: The Magnet Mine, attached to the gossan in the superficial workings.

Variety—*Petterdite.* (Twelvetrees, Pro. Roy. Soc. Tas, 1901.)

It has been shown by Dr. C. Anderson that this presumed new mineral species is but a crystallographic variety of mimetite (Anderson, "Records of the Australian Museum," Vol. VI., Part 3). Referring to the crystals the writer states, *loc. cit.*, "Three crystals, each almost 4 mm. in diameter, were measured in a two-circle goniometer. The angles obtained are only approximate, as the faces are interrupted, wavy, and slightly curved, usually yielding only a vague patch of light in the telescope. The basal plane is rough, and gives no reflection; therefore the crystals were centred by the prism faces. The system is hexagonal, the forms present being *C* (0001) and $(11\bar{2}1)$. Pyramidal faces do not occur in all the crystals, and the pyramid (1011) is the commoner and better-developed. From the measurement $0001 \wedge 10\bar{1}1 = 38° 42'$, the length of the vertical axis was found to be ·69 38. The measurement angle $0001 \wedge 1121$ is 53° 20′, calculated 54° 13′."

Occurs in the form of somewhat thin hexagonal plates or crystals, which are usually about 5 mm. in diameter, but occasionally up to 9 mm., and still more rarely of a large size. The colour is white, passing to a pale-grey on the surface. Locality: The Britannia Mine, Zeehan.

209. MINERAL PITCH. (See ASPHALTUM.)

210. MINIUM *(Red Oxide of Lead).*

Occurs as a pulverulent coating on other lead minerals and lode-matter. The colour is an unmistakable bright-red, with a feeble lustre. Locality: Whyte River Silver-lead Mine.

At the Adelaide Proprietary, Dundas, the cerussite crystals are occasionally pitted with a dull black lead-oxide, which may be this species discoloured with powdery oxide of manganese, or it may prove to be its more rare congener the binoxide (plattnerite). The minute quantity noticed prevents a careful examination.

Obtained as small encrusting patches of the usual bright-red colour in the superficial workings of the Long Tunnel Mine, Castray River.

211. MIRABILITE. (See GLAUBER SALT.)

212. MIZZONITE *(Chlorosilicate of Calcium and Aluminium).*

A scapolite, which occurs as small tetragonal crystals, with the habit of four-sided prisms. It is of a pale-brown colour, and is translucent, with a distinct vitreous lustre. The small crystals, which are somewhat irregularly grouped together, forming thus a matted mass, are individually divergent, and at times much intermixed. The crystals are elongated with distinct vertical striation. This mineral, as is not an unusual feature in the majority of the members of the scapolite group, is specially and readily liable to extreme alteration by decomposition, this when well advanced assuming the form of a dull, chalky, white, almost powdery substance, which is attached to, and encrusts in irregular patches, the matted crystals which remain unaltered. The mass of the material containing the mizzonite is usually in a very crumbling condition, and is commonly discoloured by associated earthy matter as well as by the oxides of manganese and iron. Locality: North-East Dundas.

The same species of mineral also occurs at the base of Valentine's Peak, Upper Emu River. At this locality it occurs mainly in the amorphous form, showing a granular structure, with an occasional slight fibrous tendency. The cavities or fractures are lined or coated with a thin layer of small crystals, which are fairly well developed. The crystals are irregularly interwoven, and of a very pale-brown colour.

The massive mineral is always of a somewhat pale colour, varying from almost white to a light shade of brown; more rarely there are ill-defined seams and patches of a bluish tint. It appears to be fairly abundant.

213. MOLYBDENITE *(Disulphide of Molybdenum).*

This substance is found as very characteristic graphite-like flakes, with a high metallic lustre, which are readily severable. The crystals are often met with; they are hexagonal in form, tabular, and slightly tapering, and are usually implanted in fissures and cavities of the granite or other acid rock to which the species is peculiar. Although found disseminated throughout granites and porphyries, it is more abundant in quartz veins traversing these rocks, and also in pegmatite dykes and pipes. Small crystals fairly well formed are often found at Cape Barren Island, at the Blue Tier, and at the Shepherd and Murphy Mine, Middlesex, but nothing approaching such marvellous crystals and plates of this mineral have been discovered in this island as have been obtained at the Kingsgate mines near Glen Innes, N.S. Wales. No discovery has been made of any commercial importance, although the mineral is widely distributed in the North-Eastern and Western tinfields. Occasionally the mineral is obtained coated with a thin layer of molybdic ochre, an oxide resulting from the alteration of the original sulphide, and examples in the matrix from near Lottah show a decomposition to a distinct blue-black substance, which is very likely identical with ilsemannite, which is said to be a molybdate of molybdic acid. In the granite and porphyry of the Blue Tier molybdenite is not uncommon, as small flakes and patches in association with cassiterite. It occurs at Heemskirk; with magnetite and amphibole at a locality 6 miles east of Hampshire, and west of the Blythe River; at South Flinders and Cape Barren Islands with tin ore; in garnet rock, Upper Emu River; in tough siliceous rock with columnar hornblende at Highwood on the Upper Blythe River; with garnet and hornblende in small flakes at the Whyte River; at Schouten Island; and many other localities of minor importance. The most important use for molybdenum is in the manufacture of molybdenum steel, to which it gives hardness, toughness, and elongation, without any deteriorating effect when heated and welded. It has minor uses in analysis as a reagent, as a disinfectant, and in pottery glazes.

214. MOLYBDITE *(Molybdic Acid or Oxide).*

Obtained in small quantity as a pulverulent incrustation of a clear yellow colour and dull earthy appearance on a hard dark-coloured siliceous base at the Hampshire Silver Mine (W. R. Bell); on lode-matter, mainly greisen and quartz porphyry, as a thin powdery crust with molybdenite, at the Blue Tier; on white opaque quartz at the River Iris, with the sulphide and cassiterite.

215. MONAZITE *(Phosphate of Cerium Metals).*

The late Professor Ulrich states ("Minerals of Tasmania," 1906):—"This rare monoclinic mineral occurs in aggregations of small, ill-formed crystals of light-brown colour, generally associated with wolframite, in the lodestone of the West Bischoff Tin Mine. Its discovery and determination are due to Professor Stelzner, of the Mining School of Freiberg, Saxony, on specimens contained in a collection of minerals from the Mt. Bischoff district sent to Freiberg by Mr. Kayser." In the alluvial tin-wash of the Stanley River a heavy sand occurs, which is left in the dish by the ordinary process of prospecting. It is very fine, pale-yellow in colour, and semi to quite transparent. Under the microscope it is found to be subcrystalline, and much waterworn. This is monazite, and the same remarks apply to the mineral as found at the other localities mentioned. At Salisbury, near Beaconsfield, it is extremely pale in colour, almost white, but otherwise the same. At the south side of Mt. Stronach, near Scottsdale, it occurs in fairly large quantity, and an attempt was made to work the deposit commercially, but it was found, upon analysis, that it only contained about 2 per cent. of thorium oxide, which is the valuable accessory substance that is required. The use to which the thorium oxide is put is for the production of thorium nitrate for the manufacture of incandescent mantles for illumination. At the Fraser River, King Island, an extensive deposit of fine alluvial material occurs, said to be rich in monazite (reported to be also poor in Th). It is associated with extremely minute particles of cassiterite and other heavy minerals, all in a remarkably fine state of subdivision. At the Cleveland Tin Mine, situated at the foot of the Meredith Range, the mineral under review is fairly plentiful in the tin-drift; at the Briseis, Pioneer, and South Esk Tin Mines it is not uncommon, but not of any commercial importance. It occurs at and near the Shepherd and Murphy Mine, Middlesex. In the vicinity of Lottah some comparatively coarse specimens have been obtained, but it does not appear to be plentiful at this locality. At North Heemskirk a fine granular monazite is somewhat plentiful in the alluvial tin drift. It differs from that from most other localities, inasmuch as it is darker in colour, approaching more to brown than the usual yellow. No analysis has been made as to the contained Th O_2. In short, this mineral may be said to occur in almost all the alluvial tin workings, as well as in the vicinity of many of the acid eruptive rocks. The commercial supply of monazite, which is remarkably similar to that occurring in this island, is obtained from beach workings near Bahia, on the coast of Brazil, and from alluvial workings in North Carolina, U.S.A.

16. Montmorillonite *(Hydrated Silicate of Aluminium).*

A soft unctuous clay-like substance, of peach blossom colour. It occurs in the vicinity of Chudleigh.

217. Morenosite *(Sulphate of Nickel).*

This has occurred in small quantity in one of the old abandoned mine levels at the Blue Tier, near Beaconsfield. It was found in close intermixture with other sulphates.

218. Mosandrite *(Titano-fluo-silicate of Cerium, Calcium, and Sodium).*

An accessory mineral characteristic of the elæolite or alkaline series of igneous rocks. In writing Mr. W. H. Twelvetrees respecting the garnetiferous mica-sölvsbergite of Port Cygnet, Professor Rosenbusch states that under the microscope it was found to contain "a colourless mineral, in short laths, which, judging from its refraction and double refraction, may possibly be mosandrite." The professor also states, "There is, further, present sporadically, in separate grains, a strongly refractive rusty-brown transparent mineral, which I cannot identify." Referring to a peculiar mica which also occurs in this sölvsbergite he remarks that there are "wisps of a peculiar brownish-yellow mica, slightly pleochroic, optically negative, apparently uniaxial; its cross in convergent light does not open out appreciably. This mica takes readily the form of rosettes, which in one place have collected into rectangular aggregates, the outline of which reminds one of the form of amphibole."

The garnet which is referred to under the name johnstonotite is abundant in this rock, also titaniferous magnetite, and some pyrites.

219. Muscovite *(Orthosilicate of Potassium and Aluminium).*

The common monoclinic white mica, which usually occurs in irregular scales and sheets without any regular form, owing to the retardation of development by other surrounding rock constituents.

The cleavage is always perfect, parallel to the basal plane. It is at times sufficiently transparent, coupled with the size of the sheets, to be of great economic importance. It is an essential constituent in most acid rocks, such as granites, gneiss, and similar rocks. The large sheets are usually confined to pegmatite veins, in which case the other essential minerals, with those of an accessory nature, also show an abnormally large development, and thus become of special interest to the mineralogist, as often such species as topaz, tourmaline, beryl, and garnet, among others, reach their maximum growth. In addition, such veins often contain the rarer mineral compounds.

Muscovite occurs foliated and flexible in the granite district between St. Valentine's Peak and Housetop Mountain (Pro. Roy. Soc. Tas., 1851). At Killikrankie Bay, Flinders Island, this mineral occurs in large sheets in a distinct pegmatite. It is abundant in all the granite districts.

220. NATROLITE *(Hydrated Silicate of Aluminium and Sodium).*

Although orthorhombic in crystallisation, this mineral almost constantly affects a globular, radiating structure. It is usually perfectly white, and may be transparent or translucent. It is an abundant zeolite in the alkaline igneous rocks, but is not absolutely confined to that class. The thin radiating films which occur in the clefts of the dolerite that is so profuse throughout the island have been attributed to this species. It is somewhat abundant as massive crystalline bunches and pockets of agglutinated rhombic crystals in the nephelinite of the Shannon Tier. Pseudomorphs of this mineral after sodalite are not uncommon in the elæolite syenite of Port Cygnet, and in the Tertiary basalt of Middlesex, especially in the vicinity of Bell Mount, fine rounded masses are abundant, having the characteristic radiating structure. It also occurs in the trachydolerite of Table Cape and Circular Head.

221. NEPHELITE *(Orthosilicate of Sodium, Potassium, and Aluminium).*

This species occurs crystallised in regular six-sided prisms, with or without terminal planes. The compact massive form is known as elæolite, which is an essential constituent in the alkaline series of plutonic rocks.

Nephelite readily alters to some of the zeolite group of minerals, such as thomsonite and analcite. It occurs as micro crystals in the trachydolerite of Table Cape and Circular Head; plentiful as an essential in the nephelinite of Shannon Tier; fairly abundant in the sölvsbergite porphyry and häuyne-trachyte of Port Cygnet.

222. NICCOLITE *(Arsenide of Nickel).*

The hexagonal crystals of this mineral are exceptionally rare. Its common mode of occurrence is massive, reniform, and sometimes columnar. It is also known from its colour (it does not contain any copper) as copper nickel and kupfernickel.

It is an important ore of Ni, which is always of an unusual copper-red colour. It contains empirically from 40 to 45 per cent. of Ni.

It occurs in solid to vesicular masses at a locality about 10 miles from Leslie Junction, North-East Dundas. Not infrequently it is partially coated with annabergite, derived from its alteration. It has been obtained in small quantity near Mt. Agnew, and at the Rocky River Mine it has occurred in small particles disseminated in other nickel minerals. "Occurs at Zeehan in the Austral Valley, near the foot of Manganese Hill, on the old Central Balstrup lease. The mineral is massive or forms reniform crusts in a vein carrying galena and some antimonial lead ore in a gangue of siderite. With it ruby silver ores may be found." (L. K. Ward.)

223. NICCOCHROMITE *(Dichromate of Nickel?).*

A yellow powdery substance accompanying zaratite on chromite in serpentine from the Heazlewood. A yellow incrustation, presumed to contain nickel, also occurs at Trial Harbour. The identification is extremely doubtful, but that the first mentioned substance contains Ni is beyond doubt.

224. NONTRONITE *(Hydrated Silicate of Iron).*

This is a variety of chloropal, and is always amorphous. It is of a dull greenish colour, with an unctuous feel, and somewhat waxy lustre. It always has a conchoidal fracture. Occurs near New Norfolk; as veins in the magnetite at Hampshire; and of a pale yellow-green colour near Bell Mount, Middlesex.

225. NOSELITE *(Silicate of Aluminium and Sodium, with Sulphate of Sodium).*

This exceptionally rare mineral, as occurring in Australia, is only known as a pseudomorph to limonite in the elæolite-syenite of Mt. Livingstone, at Port Cygnet.

In the elæolite-syenite porphyry of the same locality the micro crystals may prove to be an analagous mineral, known as häuyne.

In both occurrences the minerals are practically microscopic, and they can be detected in thin section under the microscope scattered throughout the slide.

226. OBSIDIANITES or AUSTRALITES *(Acid Meteorites).*

The remarkable small objects which have received the above appellations are certainly not to be considered true mineral species, but the general interest which has been recently aroused respecting them, and the fact that they are still from time to time unexpectedly occurring, principally in alluvial mine workings—in which case they are generally the cause of much speculation as to their cause and origin—must be accepted as the reasons for any reference to them in this Catalogue. Moreover, it is not by any means unusual for these objects to be considered fit subjects for elucidation by the mineralogist.

In composition they may be taken as a true natural glass, of an external dark—almost black—colour, but which shows in the thinner portions and on the edges a translucent brown bottle-green colour. In form they may be crudely classed as falling into four distinct types, viz., those of a dumb-bell form, more or less contracted in the middle, and often with a marginal groove or beading. In size these rarely exceed 3 inches in length by about ¾-inch across the spatulate ends. Secondly, those which have a discoidal form, often flat on one face and discoidal on the reverse, with a marginal rim, which is occasionally distinctly impressed on the extreme edge of the flatter surface; or this form may vary to bi-convex with a medial fluted region. Thirdly, those which may be bung or stopper-shaped, more often wider at one end than the other, and altogether much more bulky than the last-mentioned. This is apparently the commonest form, especially in certain localities in the West Australian region. Lastly, those which affect an ovate outline, or which may conveniently be termed elytron-shaped. These are more or less rounded on either side, and but rarely reach more than 2 inches in length by about ¾-inch in width, and are occasionally remarkably small and proportionately narrow. At the same time, it must be clearly understood that there is no arbitrary rule as to form, as intermediate shapes and sizes are to be met with, as well as fragments of all sizes. The forms referred to can usually be detected in fairly large collections of these remarkable objects.

The surfaces of the objects are often covered with shallow, extremely minute, pittings, which are probable gas pores, and in rare instances are of comparatively large size. In a few specimens the cavities are large and conspicuous. The surfaces also in rare instances, when the preservation has been perfect, present clear and distinct evidence of the irregular—at times curved—flow, as if of a viscid substance, which has occasionally elongated the pores or fittings referred to. A wonderfully preserved elongated specimen, of the dumb-bell type, from the alluvial workings on the Purdue Mine, near Mt. Cameron, illustrates this in a marked degree. The specimen is absolutely perfect, without any sign of abrasion. Thin sections under the microscope show a pure glass, with minute vesicles and unmistakeable optical evidence of irregular strain and stress.

They present from all localities a notable similarity in physical characters. Although not unknown in the southern portion of this island, the majority have occurred in the northern part, perhaps owing to mining operations on the alluvial drifts, which have proved safe repositories for these objects.

On the mainland they have principally occurred in the western portions of Victoria. They are reported to be notably abundant throughout South Australia in the central region. In middle and northern West Australia they appear to be plentiful, more particularly about Kalgoorlie and Coolgardie. In New South Wales they are of somewhat rare occurrence, and from Queensland none have been recorded.

It is remarkable that they are not rarely obtained in patches; for instance, in this State a batch of 17 was collected within a restricted area a short distance north of the Pieman Heads; within another small area at Camden, on the flank of Mt. Barrow, a patch or nest of nine or ten was obtained in sluicing alluvial for gold. Nearly 60 years ago a parcel of above 50 specimens of various shapes and sizes was collected at Mt. Talbot, County Lowan, Western Victoria, and sent to the Hobart Museum, where a portion of this lot is still on exhibition. They are known as "Emu stones" in the north-western portion of Australia, and about Kalgoorlie and Coolgardie the natives attribute medicinal properties to them.

Specimens from all the States of the Commonwealth, except Queensland, have been catalogued, with the result that a remarkable conformity is apparent, which distinctly suggests a common origin. The analysis further shows that they are practically distinct from all known acid rocks, and that they are certainly not of artificial origin. It is also certain that they have no connection with any known volcanic rocks, as those of the Tertiary epoch, so far as known, are all of basic composition. As a rule, they show a remarkable similarity as regards surface abrasion, although in rare instances some specimens appear perfectly fresh, as if they had been recently cast in a mould, in which case they have in all probability been thus preserved in a yielding clay or other soft substance.

Apparently they were first referred to by Charles Darwin, in his "Geological Observations on Coral Reefs," 1851. The specimen therein described was given to him by Sir Thomas Mitchell. It was found at a locality between the Rivers Darling and Murray, and was of the discoidal form. Since that time various authors have written respecting these mysterious objects, and diverse theories have been formulated to explain their distribution and origin. Some of these theories are unreasonable, and only remarkable for their originality. One writer (Mr. W. H. Twelvetrees, "Record of Obsidianites in Obsidian Buttons in Tasmania," Pro. Roy. Soc. Tas., 1905) states, "How difficult it is for geologists at a distance to appreciate the mode of occurrence," and, it might be added, to also appreciate a reasonable theory as to their origin.

Amid the various writers on the subject the beautifully illustrated thesis by Dr. Franz E. Suess, of Vienna (Die Herkunft der Moldavite und Verwandter Gläser Wien, 1900), stands out prominently for its careful and laborious investigation and elaborate detail. Dr. Suess brings strong evidence to show that there is no reasonable doubt that these objects are of cosmic origin; and the same applies with equal force to two other known occurrences of a similar character, viz., that of the well-known bouteillenstein of Bohemia, and that described by Dr. R. D. W. Verbeck, from the island of Billiton, in the Malay Archipelago, all of which are confined to Quarternary shallow alluvial deposits.

The writer has already expressed the opinion that probably but one shower of these objects occurred (Pro. Roy. Soc. Tas., 1905) in past Pliocene times, which impinged upon the earth in a generally north-eastern track crudely extending from this island to western Victoria, and thence to West Australia, thus coinciding with their line of profusion as now found.

Dr. Suess, in his treatise, proposes to call these natural glasses tektites, and to divide the group into three sections, viz.—(1) Moldavites, for those so long known as occurring in Bohemia. These are often fairly large, very irregular in shape, and all deeply indented and furrowed. They are of a clear transparent green, and have been used as gems after passing through the lapidary's hands. (2) Billitonites, for those from the island of Billiton, and also occurring in South-East Borneo and Java. These glasses are of medium size, oval form to almost round, with strongly but irregularly and deeply grooved surfaces. They are transparent, of a greenish-brown colour, in splinters, and nearly colourless, in extremely thin flakes. They would seem to vary in colour to a light-green. (3) Australites—or, as termed by R. H. Walcott, F.G.S., obsidianites ("The Occurrence of So-called Obsidian Bombs in Australia," Pro. Roy. Soc. of Victoria, 1898).

Finally it may be said to be now almost generally accepted that these obsidianites or australites, with their congeners, are of cosmic origin, and that they must be accepted as acid meteorites hurled from space over the regions indicated; those occurring throughout the Commonwealth having their parallels in the billitonites and moldavites, as referred to so briefly.

227. OLIGOCLASE *(Polysilicate of Aluminium, Sodium, and Calcium).*

This is a triclinic felspar that is intermediate between albite and anorthite. It often accompanies orthoclase in many varities of granite and trachytes, and is an essential constituent in porphyrites and andesites. It occurs in well-formed crystals in the alkaline rocks at Oyster Cove. The plagioclase felspars generally are characteristic of rocks of intermediate and basic composition.

228. OLIVINE. (See CHRYSOLITE.)

This is a common accessory constituent in most Tertiary basalts, and is an essential in the ultra-basic rocks of the Heazlewood district. ("On some Igneous Rocks from the

Heazlewood District," by W. H. Twelvetrees and the writer, Pro. Roy. Soc. Tas., 1897).

229. ORTHITE *(Orthosilicate of Cerium, Yttrium, Calcium, and Aluminium).*

This mineral is also known as allanite. It is found as occasional phenocrysts and as scattered brownish crystals in the haüyne-syenite-porphyry at Mt. Livingstone, and in the sölvsbergite porphyry south of Regatta Point, Port Cygnet.

230. ORTHOCLASE *(Polysilicate of Aluminium and Potassium).*

The common potash felspar that is characteristic of the acid rocks comprised in the granite, elvan, and rhyolite families.

Exceptionally well-developed monoclinic crystals of this felspar are abundant in the immediate neighbourhood of Killikrankie Bay, Flinders Island (Gould, Pro. Roy. Soc. Tas., 1871). The individual crystals are often 3 to 4 inches in length and proportionately wide. They are of a milky-white to yellow-brown colour, and are remarkable examples of the species. The occurrence is in pegmatite veins, which traverse the granite rock, and the associated quartz and muscovite are also unusually enlarged. Druses of crystals are not uncommon, with which well-developed topaz is not unusual. Near the Great Republic Mine, Ben Lomond, many very fine crystals have also been collected.

Orthoclase occurs massive and highly crystalline, of a flesh-red colour, on the east bank of the Mersey River, above Gad's Hill; and of a white to pale-green colour, on the west bank of the Mersey, distant about 2 miles above the crossing.

An angulated variety occurs in a pegmatite band penetrating the granite at Harmon's Rivulet, near the Parson's Hood. Fairly good crystals occur, with microcline (a triclinic potash of felspar) as a vein, in the granite near George's Bay. It is abundant in syenite, near Liena, Upper Mersey River. Somewhat fine crystals can be readily broken out of the granite at Mt. Stronach, near Scottsdale. It occurs as a constituent in the porphyroid of the Lynchford-Rosebery districts.

The glassy variety known as sanidine is abundant, often in well-developed crystals, in alkaline rocks of Port Cygnet.

At Wombat Hill, about 5 miles from Waratah, the granite on the road-side shows large crystals of this felspar thickly dispersed throughout the mass.

The localities mentioned afford the most remarkable occurrences of orthoclase that have been detected. In its normal condition it is naturally abundant throughout the granite regions of the north-eastern and north-western portions of the island.

231. OSMIRIDIUM *(Iridium and Osmium, in varying proportions, with some Platinum, Rhodium, Ruthenium, and other Metals).*

This mineral is usually found in the form of thin, shining, tin-white scales, or irregular crystalline plates of small size; but occasionally nuggets are obtained weighing up to 3 to 4 dwt. One such, from the Whyte River, near its junction with the Pieman, weighed 60 gr., the specific gravity being 19·5. Another specimen of about the same weight shows a distinct crystalline surface, and has the appearance of an aggregate of crystals. A specimen has been reported from the vicinity of the Heazlewood River measuring about seven-eighths of an inch in diameter. It has only been obtained in alluvial drift, but it doubtless owes its origin to the serpentine and peridotites of the region. At the Badger gold diggings, west of the Savage River, as well as in the Savage itself, it has been obtained in somewhat large quantities associated with gold and menacanite. At the Castray River and vicinity it has been worked under the same conditions, but intermixed with considerable quantities of picotite and fragments of chromite. At the Salisbury goldfield, near Beaconsfield, it has been obtained in small quantity, and at the Huskisson River it occurs in comparative abundance. At the Nineteen-mile Creek, which rises on the Bald Hills and flows into the Savage River, two small nuggets were found, with the normal scaly material, which weighed respectively 2 dwt. and 1 dwt. 4 gr. (F. W. Gill).

Other members of the platinoid group, such as platiniridium, iridium, and platinum, have been reported to occur, but their identification needs confirmation; the lastmentioned was stated to occur at the Wilson River, which falls into the Pieman.

Although it is known that a considerable quantity of osmiridium is, and has been for some years past, won by alluvial miners on the West Coast, mainly in the vicinity of the Savage and Pieman Rivers, no information is available as to the quantity thus obtained, as it is the custom to dispose of the mineral to private buyers.

Mr. L. Keith Ward, B.A., Assistant Government Geologist, in his report, entitled "The Tinfield of North Dundas" (1909), thus refers to the occurrence of osmiridium in the vicinity of the Pieman River:—"The creeks which carry the largest proportion of the osmiridium are those which traverse a broad belt of serpentine . . . . at a distance of about a mile from the junction of the Pieman and Huskisson Rivers . . . . In mineralogical character the serpentine does not appear to differ essentially from the other occurrences of the rock in the district. It varies in colour from dark-green to a dull greenish-yellow, and from the weathered surfaces crystals of chromite sometimes stand out in relief. The surface of much of the serpentine is entirely covered by a dense crust of residual limonite, a fact which led to the pegging of the whole outcrop in the boom days by inexperienced prospectors, who thought the iron oxide to be the gossan of a large lode-formation. . . . The extraordinary feature of these 'alluvial deposits' is the almost complete absence of 'wash.' The creeks have for the most part clean smooth beds, with occasional deposits of sedimentary material an inch or two in depth. The osmiridium is recovered by scraping up the bottoms of the creeks, which consist, as a rule, of soft decomposing serpentine. There are numerous limonite-stained crevices in the bottoms of the creeks, and these act as natural riffles and hold the osmiridium. Especial care is therefore taken to clean out these crevices."

232. PARGASITE *(Silicate of Calcium, Magnesium, Iron, &c.)*

Occurs massive, forming a large lenticular rock-mass at Mt. Ramsay. The rock is fine to fairly coarse subcrystalline in structure, of a black colour with a dull lustre. It in many respects resembles an analagous formation at Biggenden, Queensland; there is also a strong resemblance as regards the associated minerals, both containing the metal bismuth, pyrites of various kinds, and gold. In the Biggenden Mine the metallic minerals occur of a more oxidised or secondary character than at Mt. Ramsay, but both have many striking points of resemblance to each other. The same variety of rock is also abundant at the Hampshire Hills, but without many of the minerals common to the Queensland locality and Mt. Ramsay; columnar hornblende occurs at a locality about 6 miles east of the

Hampshire Hills and west of the Blythe River; it is found in combination with a large deposit of magnetic iron ore. The blades of this mineral, if they occurred without cleavage plane, could be obtained up to nearly 2 feet in length. The colour of the mineral is a very dark green to almost black. To the south-east of the Hampshire Hills a peculiar fibrous brown variety occurs: it is found in masses having much the appearance and structure of crocidolite from South Africa, and examples have been broken out measuring above 1 foot in length. At the Heazlewood an extensive mass occurs which is many feet in thickness; it occurs as aciculated crystals, intermixed with chlorite, which are interlaced, forming an almost solid compact rock of a pale asparagus-green colour. On the western side of the Heazlewood River a dark-grey coloured form has been found in considerable quantity.

Abundant near the Madame Melba Mine, North Dundas; at the Upper Arthur River it forms a rock of fine texture and intense black colour; at the head of the Savage River it occurs in large quantity as a rock of medium texture and dark colouration; at Dundas semi-serpentinised hornblende occurs, as well as the characteristic form.

Found at the Mt. Ramsay Bismuth Mine frequently in long prismatic blade-like crystals, showing the combination of the unit prism, minus pyramid and basal plane; generally intergrown with pyrrhotite. Also in similarly developed small crystals in the drift of the Emu River, and of some creeks draining into the latter in the neighbourhood of Hampshire Hills. The common black amphibole, containing aluminium, or pargasite, with the non-aluminous species tremolite and actinolite, have already been recorded (Catalogue of the "Minerals of Tasmania, 1896"), but there are several others occurring in this island which have not so far been satisfactorily identified.

At the Hampshire Hills a remarkably developed black amphibole occurs. It is in large crystals, which often reach several inches in length, and is closely associated with pyrophyllite and amethyst. In thin section under the microscope it is dark sombre-green and yellowish-green, according to the orientation. Intensely pleochroic $\mathfrak{c}=\mathfrak{b} > > \mathfrak{a}$. Extinction angle about 14°. Crystallisation irregularly prismatic and flaky, structure poicilitic, enclosing apatite, fluor, iron oxide, &c., and pierced with quartz grains; often surrounds felspar plates. Professor Rosenbusch, in a letter under date January 12, 1899, mentions this mineral as "a peculiar weakly bi-refringent monoclinic amphibole, bluish-green in colour; $\mathfrak{a}$ grey-green, $\mathfrak{b}$ brownish-green, $\mathfrak{c}$ bluish-green to blue, 2 E (the apparent optical axial angle) small, optical character + and with strong dispersion of the axes. It recalls strongly the blue-green amphiboles of the crystalline schists in the Scora Vale, in the centre and north of Norway, and elsewhere."

The series of phonolitic rocks of Port Cygnet afford one, and perhaps two, species of soda amphibole, but their specific identification is attended with considerable difficulty. Many of the rocks referred to have been microscopically examined by Professor Rosenbusch, and that well-known authority, in a communication to Mr. W. H. Twelvetrees, refers to one of the hornblendes as being barkevikitic. This is the prevailing form which is seen in rock sections from the locality indicated. It is myrtle-green in colour by transmitted light, and in the absorption $\mathfrak{b} > \mathfrak{c} > \mathfrak{a}$, in this respect appertaining more to katoforite, but differing in the pleochroism. In the fractures and joints of the elæolite syenite from the same place a black amphibole is occasionally developed, having much the general appearance of arfvedsonite. It is usually plentiful, occurring as long narrow thin laths and aggregates, sometimes reaching a trifle over 2 inches in length; they do not show terminations, but have an irregular brittle structure. Fragments examined under the microscope show the substance to be green by transmitted light. It is apparent that the soda hornblendes at Port Cygnet differ in some degree from those recorded from similar rocks in better known localities, and that they require further investigation before they can be satisfactorily determined.

Specimens of the alkaline rocks of Port Cygnet have been submitted by Mr. W. H. Twelvetrees to Professor W. C. Brögger, of Kristiana, with a request for that authority's opinion as to the definition of the hornblende therein contained. The Professor, in reply, states: "The hornblende is certainly a peculiar alkali hornblende, which I have found quite similar in various Norwegian nordmarkites. The material is not sufficient for an exact examination. The weak absorption with light bluish-green as principal colour, as well as the large extinction angle, showed the hornblende would probably contain a fair proportion of a glaucophane molecule in association with a riebeckite molecule of less quantity. Titanium contents must be small, though certain sections remind me a little of hornblendes which pass into the katophorites."

233. PECTOLITE *(Metasilicate of Sodium and Calcium).*

This substance occurs in fibrous radiating bunches of a pure white, with a silky subvitreous lustre; Upper Emu River. It is also found sparingly, of a light-green colour, in the tinguaite of Mt. Mary, Port Cygnet.

234. PELIONITE *(A Variety of Cannel Coal).*

A bituminous substance, bearing a close resemblance to the cannel coal of Scotland. From its physical appearance it has been termed "pitch coal" ("Catalogue of the Minerals of Tasmania," 1896).

Locality: Barn Bluff, near Mt. Pelion.

235. PENNINITE *(Basic Silicate of Magnesium, Aluminium, and Iron).*

This is a member of the chlorite group. It occurs in dark, olive-green masses and pseudo-rhombohedral crystals, many of the latter being $\frac{3}{4}$-inch in diameter. It appears to be closely associated with granular quartz. Tharsis Copper Mine, Mt. Lyell.

Very fine implanted crystals, which are often as much as 2 to 3 inches across, are fairly abundant at Hampshire, near the old silver mine. They are of the characteristic dark-green, almost black, colour, and often have granular quartz attached.

236. PENTLANDITE *(Sulphide of Iron and Nickel).*

This is one of the principal ores of nickel, as it is extensively mined at Sudbury, Ontario, Canada. The crystallisation is isometric, but the crystals are extremely rare. It has a bronze-yellow colour, with metallic lustre. Apparently in fair quantity with metalliferous pyrites and pyrrhotite near Leslie Junction, Dundas; near Mt. Agnew in small quantity.

Variety—*Heazlewoodite.*

A distinct variety of Ni ore occurring in the Heazlewood district. It differs from pentlandite and its congener beyrichite in several important particulars, which may justify naming it as a variety.

It is distinctly of a metallic light-yellow-bronze colour, streak bright, light bronze. Mean specific gravity of several samples tested, 4·61; hardness, 5. It occurs in rather narrow bands in the characteristic serpentine rock of the Heazlewood. It is mined in fair-sized lumps, which are usually from ½-inch to 2 inches in thickness. One peculiarity is that it is in all instances coated with a somewhat thick varnish-like film of zaratite: another is that it is highly magnetic. So far as is known, no full analysis has been made of this mineral, but the result of numerous assays distinctly shows that it is very rich in Ni. Some of these tests have given a return as high as 38 per cent. The normal beyrichite is lead-grey in colour; specific gravity, 4·7; hardness, 3 to 3·5. Pentlandite has about the same hardness and specific gravity, but the usual colour is bronze, with a bronze-brown streak. So far heazlewoodite appears to be confined to the locality above given, the Ni ores of the Dundas district belonging to distinct minerals.

237. PEROVSKITE *(Titanate of Calcium).*

This somewhat rare mineral occurs microscopically in the melilite-nepheline basalt of the Shannon Tier, as grains and small crystals of a yellowish-red colour. It is developed in the nepheline-eudialite basalt of the same locality in larger forms and without crystallographic boundaries. Dr. Paul states that it often enwraps other minerals, including eudialite in wreathed aggregates.

238. PHACOLITE *(Hydrated Silicate of Aluminium and Calcium).*

This is a variety of the zeolitic mineral chabasite, which occurs in modified crystals of lenticular form. It is abundant in basalt rocks. It occurs in plenty in the vesicles of the Tertiary basalt at Waratah, Hellyer River, Lefroy, Sheffield, Springfield, and Middlesex.

239. PHARMACOSIDERITE *(Arsenate of Iron).*

The primary form of crystallisation of this mineral is the cube, by which character it may be separated from scorodite, which is rhombic. It ranges in colour from shades of olive-green to brown. It is sectile and resinous. It occurs in some of the auriferous reefs of the Fingal district in drusy coatings of minute cubes of a grass-green colour, generally in hollows of quartz rich in arsenopyrite. The little cubes often show tetrahedral truncations of the corners. Also at Waterhouse in the quartz reefs, and at the Magnet Mine in coatings of microscopic crystals of a green colour, and bright lustre in the vesicular ferro-manganese gossan capping the lode.

240. PHILLIPSITE *(Hydrated Silicate of Aluminium, Calcium, and Potassium).*

This mineral is a common zeolite, which occurs in many basaltic rocks. It crystallises in the monoclinic system, commonly occurring as twin and compound crystals. Near the bridge crossing the Hellyer River it is very plentiful in the vesicles of the basalt; at Springfield with other zeolites; at Sheffield and in the vicinity of Bell Mount it is equally profuse.

241. PHLOGOPITE *(Fluosilicate of Potassium, Magnesium, and Aluminium).*

This species is also known as magnesia mica. It crystallises in the monoclinic system, with the habit of forming oblong six-sided prisms, which are more or less tapering. It occurs sparingly in granite at the Upper Emu River, near the Hampshire Hills. It also occurs on mineral section No. 5367-93M, in hornstone, associated with very large bodies of magnetite and zinc-blende. It is found in large hexagonal crystals with a perfect micaceous cleavage. The colour is bright-green, varying sometimes to greyish-brown.

Locality: Near Mt. Heemskirk.

242. PHOLERITE *(Hydrated Silicate of Aluminium).*

This is a soft friable substance with a submetallic, almost pearly, lustre, and scaly structure. It is so soft as to be friable between the fingers. It occurs at Mt. Bischoff; North Heemskirk, and at the South Curtin-Davis Mine at Dundas.

243 PHOSGENITE *(Chlorocarbonate of Lead).*

The chemical formula of this distinct species is written

$$Pb Cl_2 \; Pb Co_3.$$

It crystallises in the tetragonal system, and has a striking prismatic habit. It is highly adamantine, with a pale to pure white colouration, and is usually translucent. It has been found in the old slags of Laurion, Greece, where the essential chlorine has been supplied by the sea-water of the locality. In general, it may be assumed that the chlorine is derived from adjacent rocks, or with still more probability, by surface waters carrying a small percentage of chlorides. The lead is provided by the alteration of galena, to which the crystals of phosgenite are sometimes attached. Many remarkably fine specimens have been obtained at the Comet Mine, Dundas; the Adelaide Mine has also afforded a limited number; and at the Magnet some beautiful sharply-cut crystals have been from time to time found, although usually at this locality they are small in size. It is considered by mineralogists to be of somewhat rare occurrence in nature. It has also been named cromfordite, from its original locality, Cromford, Derbyshire, England. The mineralogist Breithaupt's name, phosgenite, has priority over that of cromfordite, given to the substance by Greg and Lettsom.

244. PICOTITE *(Aluminate of Magnesium and Chrome).*

This is also known as chrome spinel. It occurs in small but perfectly formed octahedral crystals of an intense black colour and high lustre.

It is extremely plentiful at certain places in the alluvial on the banks of the Heazlewood River, not uncommonly in association with particles of gold and scales of osmiridium. In the websterite dyke occurring at the Magnet, which is partially weathered, this mineral occurs sparsely scattered throughout the mass, which, on its decomposition, imparts a green colouration to the rock, as it becomes dolomitized.

245. PICROLITE *(Fibrous Serpentine).*

A pale-green, somewhat radiating, variety of serpentine fairly agrees with the above. It is often translucent, and occasionally almost asbestiform. It occurs with bastite and chrysotile at North-East Dundas; with magnetite and pyrite of the Rio Tinto, Savage River. With the former it is often closely associated.

246. PILOTITE *(Hydrated Silicate of Aluminium and Manganese).*

An altered variety of actinolite which has been termed "rock cork." It occurs in felted fibrous masses, of a pale-grey to almost white colour, in considerable quantity at a spot east of the "Red Face" at the Mt. Bischoff Tin Mine.

247. PIMELITE *(Hydrated Silicate of Aluminium, Nickel, and Magnesium).*

This doubtfully homogeneous substance is always of an apple-green colour. It is of rare occurrence as small nodular patches in the veinstone of the Heazlewood Silver-lead Mine, attached to siderite, which is itself often stained green by chrome and nickel; it also occurs as an incrustation on other nickel minerals near Trial Harbour, West Coast.

248. PINITE *(Hydrous Silicate of Aluminium and Potassium).*

Under this name are included many amorphous alteration products of various minerals, such as felspars, micas, and others. The chemical composition practically represents muscovite. As occurring in this island it is in the form of irregular lumps, which are a close representation of that peculiar variety of quartz which is known as "slashed" or "chopped" quartz, occasionally found in the stanniferous drift of the eastern tin mines, as well as in the auriferous drift of the Lisle goldfields. The pinite apparently filled cavities that had been in the granite, and taken impressions of angular crystals, which protruded from the walls of the cavity. This substance has occurred at Moorina and other localities.

249. PITTICITE *(Arseniosulphate of Iron).*

A doubtfully homogeneous amorphous substance, of a dark, almost black, colour, and greasy lustre, that would appear to result from the alteration of arsenopyrite. It occurs in limited quantity in the vicinity of the Scamander River; at Mt. Pelion (Montgomery); and at North-East Dundas it occurs as a thin coating, of an intense brown colour, on niccolite.

250. PLAGIONITE *(Sulphantimonite of Lead).*

This mineral occurs as indistinct small tabular crystallisations, that are grouped together in druses, and as irregular massive specimens of small size. In colour the samples obtained are of a dark-grey, but are generally much tarnished.

Locality: The Heazlewood Silver-lead Mine.

251. PLATINUM, Native.

This metal has been reported to occur at St. Paul's River; at the Pieman goldfield; as minute flakes in auriferous wash at Salisbury, near Beaconsfield, and at Wilson's River (which is a tributary of the Pieman). All the identifications are doubtful, and need confirmation.

252. PLEONASTE *(Aluminate of Magnesium and Iron).*

Also known as black spinel and as ceylonite. It is intensely black, opaque, and has a high polish with a strong conchoidal fracture. It is one of the minerals termed "black-jack" by the north-eastern tin miners. It is extremely abundant in the alluvial tin-drift, usually occurring as waterworn lumps of small size, and but rarely showing any indication of crystal outline. It is commonly associated with zircon, sapphire, and quartz.

It is plentiful at Weldborough, Moorina, Branxholm, Mt. Cameron, Hampshire, in small pieces at the Blythe River, and in small quantity at the Denison goldfield. The red and other coloured spinels are not known to occur in this island.

253. PLINTHITE *(Hydrous Silicate of Aluminium).*

An amorphous clay-like substance of a brown colour, with conchoidal fracture, but of doubtful homogeneity, being in all probability but an indurated mixture. It occurs near Falmouth.

254. PLUMBOGUMMITE *(Hydrated Phosphate of Lead and Aluminium).*

Occurs in stalactitic and irregular globular and botryoidal forms of a pale-brown colour, with a resinous lustre. It was found attached to partially decomposed galena at the British-Zeehan Silver-lead Mine.

255. POLYSPHOERITE *(Hydrated Phosphate of Lead and Calcium).*

This mineral occurred as minute rounded pellets, which had an internal radiated structure. Colour brown, with a somewhat greasy appearance. It was found intimately associated with bunches of pyromorphite and cerussite at the Sylvester Silver Mine, Zeehan (A. J. Taylor).

256. PORCELLANITE *(Silicate of Aluminium).*

This is a milk-white, compact, and smooth porcelain-like substance, with a glimmering conchoidal fracture. It is not strictly a mineral species, but is apparently an indurated clay. It occurs sporadically in the vicinity of Mt. Lyell.

257. PRZIBRAMITE *(Sulphate of Zinc and Cadmium).*

Cadminiferous blende has been obtained near the Scamander River, on the East Coast; at several localities in the Ben Lomond district; and more sparingly at the Heazlewood.

258. PSILOMELANE *(Hydrous Manganese Manganate).*

Amorphous, botryoidal, and stalactitic, of a dark colour, with submetallic lustre. The common mode of occurrence is in the stalactitic habit in cavernous gossan, and it is often very impure.

It is abundant at the Penguin River; at the Heazlewood and Dundas it occurs in the lode outcrops, and forms considerable proportion of the outcrops; at the Heazlewood and Magnet it also occurs in quantity.

259. PYCNITE. (See TOPAZ.)

260. PROSOPITE *(Hydrous Aluminium and Calcium Fluoride).*

Occurs as a granular powder, which is often kaolinised. Its probable origin is from the decomposition of topaz porphyry. It occurs closely intermixed with partially decomposed green tourmaline at Mt. Bischoff.

261. PROUSTITE *(Sulpharsenite of Silver).*

This attractive mineral was first detected in minute bright crimson patches, intermixed with other minerals, at the Bell's Reward Mine, Heazlewood, and has more recently occurred at many of the silver-lead mines, but only in small quantity. At the Magnet Mine it often occurs as patches of extreme tenuity coating the dolomite gangue. These patches are at times intermixed with or surrounded by native silver, appearing as if the latter were derived from its decomposition. A small number of bright, sharply cut crystals have occurred, but they are of extreme rarity. At the Hercules Mine the surface of the schist rock, and at times the complex mixture of zinc and lead sulphides, are often coloured red by a thin coating of this mineral, with which the dark ruby silver, pyrargyrite, is sometimes associated. At the Zeehan mines it has been detected, notably at the British-Zeehan Mine. It has been found at the North Farrell Mine, at Tullah; at the Long Tunnel Mine, at Heazlewood; and in several other localities; but always in small quantity, and usually as thin films.

262. PYRARGYRITE *(Silver Sulphantimonite)*.

Ruby silver ore has recently occurred at several mines, notably at the Magnet, where it is not by any means rare, in patches and blebs in close association with galenite. The mineral is sometimes surrounded by frondose and granular native silver, and the combination, needless to say, adds materially to the silver assay value of the ore. At the Mt. Stewart Mine it occurs sparingly, and in small vughs little nests of micro-rhombohedral crystals have been detected, which are probably this mineral. At the Mt. Farrell Mine it has been noticed embedded in galena; also at the Confidence Mine near Waratah, and at the Hercules Mine; Mt. Read, it has been seen in micro-crystals attached to filaments of native silver. Reported to have been found at the Oonah and British-Zeehan Mines at Zeehan.

The light ruby silver ore (proustite) is sometimes associated with the pyrargyrite; the latter appears to be the more often noticed, but the exact determination of the species has not been made in the majority of occurrences.

At the Magnet Silver Mine this mineral has recently been obtained in small, but perfectly-formed, characteristic rhombohedral crystals nestling in cavities in the lode gangue associated with galena and blende in the southern working of the mine. They are dull-black in colour, due to tarnish, but readily give the bright-red streak, as well as the conchoidal fracture, when broken. The mineral in its compact and investing forms is not by any means rare, but the crystals are extremely so; in fact, they appear to have been first detected in this State.

263. PYRITE *(Sulphide of Iron)*.

With the exception of quartz, this is, in all probability, the most widely distributed and abundant mineral in nature, and it is especially plentiful in many portions of this State. It is commonly known as iron pyrites in contradistinction to copper pyrites; and also as mundic, a Cornish term, which is now universally employed. The composition is iron disulphide, with occasionally a few atoms of iron replaced by copper, in which case it may be termed a low-grade copper ore, the empirical composition being S 53·4, Fe 46·6. The large proportion of sulphur renders it of the utmost importance in the process of pyritic smelting, and also in the manufacture of sulphuric acid, more particularly in the production of superphosphates. Pyrite crystallises in the isometric system, and is commonly found in well-defined cubes, which often reach a comparatively large size, specimens occurring occasionally nearly 6 inches in diameter. The pentagonal dodecahedron is so characteristic of pyrite that it is known as the pyritohedron. It is often found in sharply defined, highly polished crystals. Many other modifications of crystallographic structure are well known, and they form a distinctive group. The auriferous pyrites is well known, and is of considerable economic importance; the gold is not chemically combined, but in the form of minute particles, as may often be detected by the aid of the microscope, scattered throughout the substance of the pyrites, or implanted in the lamellæ.

The auriferous variety occurs at Beaconsfield, Lefroy, Mathinna, and at the other reef gold-mining localities. Notable localities for the massive, granular, and sub-crystalline varieties are Mt. Read; Dial Range, in extensive bunches of crystals; River Forth; Mt. Kershaw, north of the Pieman River; Savage River; and many other places.

Interesting bunches of well-formed crystals have been obtained at the Curtin-Davis Mine, in association with tetrahedrite. At Heemskirk some rather fine crystals of the pyritohedron habit have been collected, and numerous other localities have afforded crystals of more or less interest, but they are usually somewhat small. In the Mt. Lyell copper-gold-silver mining district this mineral has been discovered and mined in enormous quantities, the most important being that operated upon by the Mt. Lyell Company. It comprises a vast contact deposit—bounded by quartz conglomerate and schist of doubtful origin—of pyrite, containing small quantities of copper, gold, and silver. The main body is apparently of oval form, approximately about 900 feet in length by 700 feet in width, and gradually lessening in bulk as depth is attained. There are occasional enrichments, consisting mainly of irregular masses of bornite and stromeyerite. At the Stirling Valley, between Tullah and Rosebery, a deposit occurs, with which are associated several bands of cubical galena. The pyrite is for the most part granular, with pockets of small, fairly-developed crystals.

"At the Federation Mine, Mt. Heemskirk, in a lode-formation in altered granite, there occur very symmetrical crystals. Striated cubes and smooth-faced or striated pyritohedra are found as simple forms, and combinations of both cube and pyritohedron are common. The extent to which the two forms are represented in the combinations is variable. All forms found at this locality are remarkable in this respect, that they carry anhedral grains of cassiterite sporadically distributed. Pyrite occurs in the form of small but perfect octahedra in vughs in the pyritic ore-body of the Montana No. 2 Mine at Zeehan. The forms are simple and quite free from striæ." L. K. Ward.)

264. Pyrochlore *(Columbate and Titanate of Calcium, Lanthanum, Cerium, &c.).*

This rare mineral, or a species allied thereto, has been discovered on what was known as the Shekleton Mining Syndicate's property, whose seat of operations was near Table Cape.

It occurs in a granular condition, of a brown colour, in alluvial drift, with zircon in abundance, and more sparingly sapphire, the main portion of the wash being a quartz grit. "The Australian Mining Standard" of October, 1896, states that an analysis by Dr. W. H. Craze gave the following result, viz.:—

"A mobate of uranium and chromium, a variety of pyrochlore:—

		Per cent.		Per cent.
Ur	...	5	to	0·5
Ch	...	10·5	to	12·5
Ti	...	12	to	13
Ni	...	4·5	to	2·5
Fe	...	25·5	to	27·7
Al	...	7·3	to	6·2
Ca	...	2·6	to	1·5
Si	...	15	to	12
Di	...	7·5	to	0·5
La	...	6·2	to	2·2
Th	...	1·0	to	traces
Yt	...	1·5	to	traces

Professor Rosenbusch, the eminent petrologist, in a communication to Mr. W. H. Twelvetrees, states that the mica sölvsbergite of the Port Cygnet complex contains a mineral in small quantity which may belong to the pyrochlore group. It is strongly refractive, red, transparent, and isotropic.

265. Pyromorphite *(Chlorophosphate of Lead).*

This is the most important member of an isomorphous group of arsenates, arsenophosphites, and phosphates of lead, which crystallise in the hexagonal system. The origin of all the species forming this group is in all probability to be sought in the mispickel or apatite in the lode-matter of its vicinity, by affording the acid radicals to lead supplied by the alteration of lead sulphide. These secondary minerals in their highest development are found some distance from the actual outcrop. In pyromorphite the phosphorus sometimes gives way to arsenious acid, and by this change the mineral graduates to the chloro-arsenate, or vanadic and chromic acids may act in the same manner, and thus constitute the other members of the group. The Sylvester Mine, at Zeehan, has afforded the largest and most perfect crystallised masses of this mineral so far obtained in this State. The crystals are intricately interwoven, the normal colour being an intensely dark-green. At the Godkin Mine, Whyte River, it is found in minute crystals, and as earthy pyromorphite in large blocks, being in this condition mixed with clay, and at times pyrolusite; in small veins with cupriferous pyrite and galena in a quartz gangue at the River Lee. At the Hercules Mine a limited quantity of attractive crystal groups has occurred. At the Magnet Mine the crystals are well developed, but usually somewhat small. The colours vary at this locality in a remarkable degree, ranging from milk-white to pale and dark green; again yellow and shades of dark port-wine tint. It is found also at many of the silver-lead mines of Zeehan, Dundas, and the Heazlewood; but these minor occurrences do not need special reference.

266. PYROLUSITE *(Oxide of Manganese).*

An abundant and widely distributed mineral, commonly found in botryoidal, radiating, or granular masses, rarely crystallised. It is black or bluish-black in colour, and is much softer than psilomelane.

Alluvial drift is often cemented into a compact mass by ferro-manganese, which is a mixture of this mineral and limonite. Its more important localities in this island are:—Penguin River, Heazlewood, Vale of Belvoir, Mt. Claude, Zeehan, Dundas, Meredith Range, Pieman River, Fingal, and the Dial Range. At the Balstrup Manganese Hill Mine, at Zeehan, small crystals occur intermixed with the more profuse radiated masses.

267. PYROXENE *(Bisilicate of Iron, Magnesium, Calcium, &c.).*

A petrologically important family of ferro-magnesian rock-forming minerals, which are well represented in those of igneous origin. They are divided into two well-established groups, viz:—

(1) *Rhombic Pyroxenes.*

Enstatite, with less than 5 per cent. of Fe O.
Bronzite, with 5 to 14 per cent. of Fe O.
Hypersthene, with above 14 per cent. of Fe O.

The most highly ferriferous is termed amblystegite, and the fibrous variety is known as bastite.

(2) *Monoclinic Pyroxenes.*

Augite, dark-coloured variety,
Diallage (this alters to schiller-spar), and
Various green to white varieties.

The first are abundant in various rocks of igneous origin, such as diorites, porphyrites, andesites, and some peridotites. The last occur also in plutonic and volcanic rocks, especially those of a basic nature—basalts, gabbros, andesites, &c.

268. PYROPHYLLITE *(Hydrated Silicate of Aluminium).*

This mineral is very plentiful at the Mt. Bischoff Mine in close association with various forms of pyrites and cassiterite. It forms radiating aggregations of thin scales, which have a yellowish-white colour and glimmering lustre. Before the blowpipe the substance exfoliates and swells to a large size, and with nitrate of cobalt solution it strongly reacts for aluminium. At the Shepherd and Murphy Mine, Bell Mount, it is fairly common in small radiating patches, which are often implanted on quartz, and may contain imbedded crystals of cassiterite. At North Heemskirk it is also plentiful under the same conditions, but it is usually at this locality of a paler, almost white, tint.

Mr. R. Sticht has very kindly forwarded me several examples of what is undoubtedly pyrophyllite from the Mt. Lyell district, as well as one from a locality a few miles north of the Emu Bay Railway Company's bridge crossing the Pieman River. That from the North Mt. Lyell Mine is a massive form, with a micaceous scaly structure; it has a glimmering lustre, and is of a pale-greensh colour.

The analysis gave the following result:—

		Per cent.
Silica	=	62·3
Alumina	=	31·4
Ignition loss, *i.e.*, combined water	=	6·02
		99·72

Respecting this substance, Mr. Sticht remarks:—"Judging from the analysis mentioned below, there might be slight traces of alkalies present, but these would have no special bearing on the composition otherwise." It occurs at the 850-feet level, associated with the quartzite schist, and in connection with a 15-inch seam of chalcopyrite, 15 feet from the conglomerate or the contact of the same with the schist.

At the 700-feet level of the same mine a variety of this mineral is found close to the conglomerate. It occurs as a finely-divided aggregate of scales of a pale yellowish-green colour, with a semi-metallic sheen. It is much less compact than the one above referred to.

The analysis shows the following composition:—

		Per cent.
Silica	=	60·20
Alumina	=	31·90
Potassium oxide	=	0·20
Sodium oxide	=	0·07
Magnesium	=	nil
Lime	=	nil
Ignition loss, *i.e.*, combined water	=	7·50
		99·87

At the Lyell Company's Chester Pyrites Mine, in the North Pieman district, the mineral occurs in considerable quantity; in fact, it forms the great bulk of the country-rock in which the pyrites is contained. At times it constitutes veins in the solid pyrites. It is composed of small white scales with a distinctly silvery sheen. Apparently it has partly undergone kaolinisation, and this may account for the slight divergence in composition from the normal type. This alteration is shown by the analysis, which is as follows:—

		Per cent.
Silica	=	59·8
Alumina	=	33·8
Ignition loss, *i.e.*, combined water	=	6·5
		100·1

Specific gravity = 2·78.

It would appear that this almost compact to scaly granular pyrophyllite forms the base of some of the schistose rocks which are characteristic of the localities indicated.

"At the North Lyell Mine a compact massive form of this substance occurs. It is of a pale-green colour, has a smooth and unctuous feel, and exhibits distinct translucency at the margin of thin flakes.

"Upon analysis it gives the following result:—

	Per cent.
SiO_2 =	59·0
Al_2O_3 =	32·05
Combined H_2O =	7·2
	98·25

The oxygen ratio is 31·5 : 15·1, practically resembling the mineral from the Chester Mine, North Pieman." (R. Sticht.)

269. PYROSTILPNITE *(Silver Sulphantimonite).*

A rare ore of silver (containing 59·44 per cent. of Ag) known as "fire-blende." It crystallises in the monoclinic system, and is sometimes tabular, but its common habit is in imperfectly terminated sheaves or irregular bunches—like stilbite—but of almost microscopic dimensions. It is of a hyacinth-red colour, but is generally tarnished to an almost black discolouration. When free from discolouration it has an adamantine lustre and decided red streak. In minute vughs it may be detected in association with nests of small quartz crystals. When coating cleavages in its extremely silicious gangue it soon arrests attention from its peculiar habit of occurrence in radiating and irregular bunches, by which feature it may be known from proustite, although both have the same bright colour. Before the blow-pipe it fuses easily, giving off white antimonial fumes, and with soda affords a bead of silver. It occurs in limited quantity, but quite enough to make an appreciable difference in the bulk silver assays. Locality: The Long Tunnel Mine, Heazlewood. Associated with this is another silver mineral of an orange-yellow colour with yellow streak. It affects a frondose habit, and is found in exceedingly limited quantity as aggregates in the cleavages of the gangue. It may be xanthoconite (a silver sulpharsenate, crystallising in the rhombohedral system), but the quantity is too small to make reasonably certain of it's exact identification. Pyrostilpnite occurs at the Oonah Mine, Zeehan, closely associated with pyrite in cellular quartz.

270. PYRRHOTITE *(Sulphide of Iron).*

Also known as magnetic pyrites. It crystallises in the hexagonal system, but the crystals are extremely rare. The only known occurrence of the crystals in this island is at the Colebrook, North-East Dundas, where they occur of the usual diminutive size, in small clusters on the parent mineral. The amorphous substance also occurs at this locality in immense quantity in close association with axinite and a little arsenopyrite, datolite, and chalcopyrite. The pyrrhotite is of the usual bronze colour, with a noticeable tarnish of the brighest shades of red, blue, and green, which gives it the pseudo appearance of being an ore rich in copper. Occurs as a large massive formation near George's Bay; at Mt. Ramsay in amphibole rock, with native bismuth and other minerals; in main adit at Mt. Bischoff the samples weather to a normal bronze lustre; at Hampshire in amorphous masses, which have a decided red tinge, and also of a grey colour, disseminated in a hard metamorphic rock; Penguin River, where it is highly nickeliferous; Dundas, said also to carry nickel; samples from the Blue Tier, near Beaconsfield, have been found to contain nickel, and in the old adits the mineral has decomposed to a mixed sulphate of that metal and iron; Beaconsfield, where it is often auriferous; Mt. Pelion, in enormous masses; Rocky River and Savage River, in considerable quantities; Barn Bluff, with actinolite and pyrites.

271. QUARTZ *(Silica).*

This abundant and widely diffused mineral is common both in the amorphous and crystallised form. The crystals occur as hexagonal prisms, which sometimes have pyramidal terminations at both ends. It is found in many parts of the island, often in considerable abundance. The crystallised form more especially is met with in profusion in the tin-mining districts, where examples of large size, more or less waterworn, and showing a wide range of colouration, form one of the main features of the stanniferous drift. On Flinders Island and in the vicinity of Mt. Cameron individual crystals weighing many pounds are commonly obtained. They are known as "rock-crystal," and are beautiful representations of the species. In the auriferous districts the quartz is usually more or less milky-white owing to enclosed vesicles, but extremely fine bunches of clear colourless crystals have been obtained at several localities. At the Heazlewood, quartz, often coloured green with the oxide of chrome, is an abundant admixture in the lode gangue of the silver-lead mines; and on the West Coast crystals coloured red with iron oxide have been obtained. At Beaconsfield a honeycombed form occurs; this apparently has resulted from the decomposition of pyrites. Masses of a similar character have been found at the Pieman River and other places.

At the Vale of Belvoir, quartz occurs pseudomorphous after tremolite, and silicified wood, which is of similar origin, is abundant in many places. At Ben Lomond, in the workings of one of the tin mines, quartz has been found pseudomorphous after felspar; the specimens have a peculiar mottled appearance of various shades of brown.

A peculiar variety known as "hacked quartz" occurs at several of the East Coast alluvial tin workings and at the Lisle goldfields. Some specimens from the lastmentioned locality are remarkably fine and fresh, as well as being of unusually large size—at times quite 2 feet in length. The origin of this variety has caused no little speculation. Its original home was probably formed by the infiling of vughs in the granite rock. The peculiar hacked impressions on most of the faces of the irregular mass are the imprints on felspar or other crystals which originally lined the cavity. It would appear that silica in solution percolated through the granite into the cavity, and in hardening, retained the image of its form and lining, thus becoming the veritable casts which are now found in the alluvium.

At the Hercules Mine, Mt. Read, many of the small quartz crystals are both "left-handed" and also "right-handed," and in some cases, in addition to the W and Y trapezoids, show the rhombic face S. The last has also been detected in some of the crystals from the vicinity of Bell Mount, Middlesex. At the North Lyell Mine many small quartz crystals occur, which are flattened in the plane containing the principal axes, and mackled with another crystal on 52$\bar{1}$ intersecting in a zig-zag line. These twins are known from the Dauphine, and also from Japan.

On the sand hillocks skirting portion of the coastline of Flinders Island, Bass Strait's, novel forms of siliceous concretion have been collected. They are known as fulgurites or vitrified sand, produced by the action of lightning on the sand dunes. They are circular, thin, about 2½ inches in diameter, with a concentric structure, and more roughened on what is apparently the upper surface than the lower.

"On the Linda track, between the Rivers Collingwood and Franklin, a remarkable pisolitic variety occurs as loose boulders. It is difficult to account for this granular growth, which appears to be in layers one over the other, and has the appearance of a siliceous oolite. The concretionary spherules are individually about 1 mill. in diameter." (L. K. Ward.)

"A finely fibrous, somewhat silky-looking variety of this mineral, in interlaminations up to ¼-inch thick, much resembling some aragonite deposited from thermal springs, occurs in the Australasian Slate Quarry, Back Creek." (Ulrich.)

Endomorphs in quartz, which is usually more or less cloudy in appearance from enclosed substances:—

Rutile.—Moorina; Mt. Cameron.
Cassiterite.—Gould's Country.
Tourmaline.—Ben Lomond; Moorina; Mt. Heemskirk.
Iron Oxide.—In capillary fibres (known as venus hair stone), Kindred-road, near the River Forth.
Manganite.—In solid dendrites in semi-opal, North-East Coast.

Principal Varieties of Quartz.

Rock-crystal.—Vitreous form with a glassy appearance, commonly transparent and colourless, but occasionally tinted with yellow and brown. Mt. Cameron, Gould's Country, Moorina, Thomas' Plains, Lefroy, Mt. Maurice, Mt. Heemskirk, Beaconsfield, Dundas, Ben Lomond, Flinders and other islands in Bass Strait, and other localities.

Cairngorm.—Smoky-brown of various shades. Blue Tier, Moorina, Mt. Cameron, Flinders Island, &c.

False Topaz.—Of a clear pellucid yellow colour. Mt. Cameron, Moorina, Gould's Country, &c.

Hyallite.—This variety has been found in the form of beautiful globular concretionary masses and incrustations with a pearly lustre. Zeehan, Gould's Country, Rio Tinto Mine (Savage River). "Occurs in small mammillary colourless transparent coatings in hollows of the basalt near Surrey Hills Station on the road to Mt. Bischoff." (Ulrich).

Resinite.—A form of semi-opal of dull-brown colour and resin-like appearance. Flinders Island.

Wood Opal.—Silicified wood, usually of a pale-brown colouration, with a striated structure. In drift, Derby; Flinders Island; Epping Forest; Longford; Launceston; in concentric layers, Franklin Rivulet; East Arm of Port Sorell; near Latrobe; Kentish Plains; white, of a fine silky texture, Queen River, east of Howard's Plain; of a bright colouration and compact form, Little Forester River; Lake Sorell; Conara; Swansea; pseudomorphous after stems, Hobart.

Cacholong.—A milk-white, compact, siliceous substance, occurring as thin veins and filling cavities in basalt; it is opaque, and usually somewhat dull in lustre. Near Launceston.

Prase.—Amorphous, usually of a yellowish-brown and waxy lustre, Hampshire Hills; as brown to dark-green waterworn pebbles, Lake Sorell; with adularia and ordinary quartz in the granite rock near its junction with metamorphic slate, Tasman Rivulet; a brown porcelain-like form is abundant at the Magnet Range.

Agate.—A variegated variety of quartz, the colours being arranged in bands, concentric layers, and cloudy masses. River Leven; Cranbrook, near Swansea; River Forth; Flinders Island; Cornelian Bay; Lake Sorell; Heazlewood; and other places.

Morion.—Black quartz. Blue Tier; Flinders Island; Ben Lomond; a mammilated black quartz in a solid compact form occurs on the west branch of the Savage River, nearly opposite Long Plain.

Hornstone.—A variety resembling flint, opaque to translucent, dull and glimmering lustre. In colour, from white to black Lydian stone. Lilydale; Oyster Bay; Flinders Island; Cornelian Bay; Mt. Nelson; Mt. Bischoff; Pieman River; Macquarie Harbour; River Forth; and elsewhere.

Common Opal.—An amorphous hydrated form of a milk-white to pale-brown colour and vitreous lustre. Port Cygnet; Lake Sorell; Cornelian Bay; Macquarie Harbour; Supply Creek; Mt. Cameron; Pieman; Dugam Range, near the Montagu; Proctor's-road, near Hobart.

Menilite.—A dull brownish to white translucent variety of common opal, occurring in irregular reniform lumps or nodules, which are impressed on the surface with angular depressions. In stanniferous drift, Gould's Country.

Geyserite.—A white hydrated form, occurring in cellular masses mixed with native sulphur. Mt. Bischoff.

Rose-quartz.—Of rare occurrence, and then not nearly so clear as that obtained in Bavaria and other places. Local examples are generally somewhat ferruginous and cloudy. West Coast; Beaconsfield; Moorina.

Amethyst.—Of a beautiful clear violet colour. A gemstone much in use for ornamental work. In large detached abraded crystals in stanniferous drift at Moorina; in the Emu River, about 4 miles south of the Hampshire Hills; also occurs at Mt. Cameron and Blue Tier.

Chalcedony.—Semi-transparent, with a waxy lustre; often in mammillated form, but never in a crystallised condition. Of a greenish and brown colour, apparently infiltered in cavities and seams at Beaconsfield; in banded brown-coloured masses at Flinders Island; as waterworn pebbles, Swanport; Lake Sorell; Tamar Heads; Cornelian Bay; Lisle; Mt. Cameron; Meredith Range; Heazlewood; Pieman River; Zeehan; as crustified masses, Corinna, Pieman River.

Cornelian.—Of a more or less variegated red colouration, often banded with white and yellow, and sometimes showing crystalline aggregations. Fingal; Flinders Island; Swansea; River Forth; Cornelian Bay; Lake Sorell; Ilfracombe; Supply Creek; Longford; and many other localities.

Jasper.—Usually dull-red colour, but sometimes green or yellow. Near Corinna in alluvial drift with crustified chalcedony and quartz; a close, compact green variety, not unlike the New Zealand greenstone, occurs in the Arthur River, about 6 miles below Waratah.

272. RANDANITE *(Infusorial Earth).*

Found in small quantity; contains many fresh-water forms of diatomaceæ. Inglewood, near Oatlands (Burbury); in depressions between the dolerite hills of the neighbourhood; it has been found in thin seams occasionally ranging up to as much as 12 inches in thickness, and sometimes very pure.

273. RESTORMELITE *(Hydrous Silicate of Aluminium and Iron).*

As at its original locality, Restormel Mine, Cornwall, this substance occurs as a coating on psilomelane and other manganiferous material. It is white to pale-greyish blue, sometimes almost a clear blue. The incrustation is invariably thin, but quite noticeable and distinct.

Locality: The Comet Mine, Dundas.

274. RETINALITE *(Yellow Serpentine).*

A massive, resinous yellow variety of this mineral substance. It is usually translucent. It occurs at Dundas with the normal variety.

"This variety of serpentine, in roundish pebble-like pieces of light-yellow to brown colour, and translucent, much resembling resin, was found by Mr. W. R. Bell, on the Parson's Hood Range." (Ulrich.)

275. RHODONITE *(Silicate of Manganese).*

Information from Zeehan states that this mineral has been found there, but the statement requires confirmation. It usually occurs massive, opaque, and flesh-red in colour, often coated black externally from exposure. Some beautiful examples have been obtained from the New England District of New South Wales. (Cox and Ratte, "Mines and Minerals.")

Massive, in a somewhat impure form, forming part of a vein of scapolite in a large asbestos seam in serpentine on the ground leased to the Australasian Asbestos Company, at Anderson's Creek, west of Beaconsfield. Called "red quartz" by the miners. (W. H. Twelvetrees.)

276. RINKITE *(Titano-fluo-silicate of Sodium, Calcium, and Cerium).*

A substance that is presumed to be this occurs somewhat plentifully in the garnetiferous mica sölvsbergite of Port Cygnet. It is colourless to rose without crystallographic outline, and with imperfect cleavage. It belongs to the minerals of the first generation in this rock.

277. RHODOCHROSITE *(Protocarbonate of Manganese).*

This well-marked and attractive rose-red-coloured mineral is also known as diallogite. It has been obtained at several of the Zeehan mines commonly coating ferro-manganese cavernous gossan, the hollows often containing somewhat fine aggregations of the substance. At Dundas it occurs under similar conditions; while at the Magnet Mine it is not unusual to see it in bands alternating on either side of the central crustification of that laminated ore-body. The finest development of this mineral as occurring here is at the mines at Mt. Read, with more especial reference to the Hercules Mine, at which most attractive specimens have been obtained. These mainly consist of finely cut crystals and nodular patches, intermixed with small water-clear quartz crystals and pale tinted fluorite.

Cavities in the ore-body are sometimes found completely lined with the substance, with which the sulphide ores are intermixed. It also forms seams and masses of the characteristic rose colour.

278. RUTILE *(Binoxide of Titanium).*

This mineral crystallises in the tetragonal system, and is one of the modifications of the trimorphous body $Ti\ O_2$; the others being brookite and anatose.

Titanium dioxide has been formed artificially by the reaction of titanium fluoride and water vapour. The process is therefore really analogous to that which has yielded cassiterite; indeed, stannic oxide and titanic oxide stand in close chemical relationship. Pneumatolytic action may thus be invoked as a possible explanation of the genesis of these minerals (Rudler). The species of titanium oxide have been formed artificially, and are dependent upon various temperatures, rutile being formed at a red heat; at a temperature such as would volatilise zinc brookite was produced; and at a temperature just below that at which cadmium may be volatilised anatase results. This mineral is abundant in the alluvial drift, but much rounded, at Brown Plains; about the south-west base of Mt. Lyell; in waterworn fragments, and occasionally as well-formed crystals, Clayton Rivulet; in red-brown to almost black capillary bunches penetrating quartz crystals, Moorina and other places.

Occurs in large quantities in grains and slightly waterworn crystals up to ½-inch in length in surface-drift, and enclosed in a brecciated sandstone on the top and slope of a hill situated a short distance from Hamilton-on-Forth. The crystals are usually well-formed, including angulated twins, but have mostly rough faces. The colour varies from light to dark-reddish brown. Metagenic twins are of frequent occurrence. The variety called nigrine, of a very dark-brown to black colour, occurs abundantly in small waterworn grains and imperfect crystals in drift at Rocky Cape. It is very plentiful in auriferous drift at Lymington, Port Cygnet. At the Penguin River and vicinity it is fairly common.

279. SANDBERGERITE = KUPFERBLENDE. (See TENNANTITE.)

280. SANIDINE *(The Glassy Variety of Orthoclase).*

This is the glassy variety of potash felspar that occurs in imbedded crystals in various igneous rocks. Plentiful as fine bold crystals, often showing zonal growth, in the sölvsbergite-porphyry and the elæolite-syenite of Port Cygnet.

281. SAPONITE *(Hydrous Silicate of Aluminium and Magnesium).*

A soft, massive substance, which becomes extremely brittle on drying. It occurs in patches of a yellow to brown colour, with chrome ochre and loose quartz on the hanging-wall of an irregular quartz reef, at what was known as the Duchess of York Mine, Salisbury, near Beaconsfield; also occurs as a white amorphous substance near Trial Harbour, West Coast.

282. SAPPHIRE. (See CORUNDUM.)

283. SCAPOLITE. (See MARIALITE.)

284. SCHEELITE *(Tungstate of Calcium).*

This mineral is tetragonal in crystallisation, but in habit the crystals are the bi-pyramid, which have a striking similarity to the regular octahedra. The colour is always pale in tint, with a vitreous lustre, inclined to resinous on the surfaces of fracture, which is uneven to subconchoidal and brittle, streak white. The substance was named in compliment to the chemist Scheele, who discovered the element tungsten in this mineral. Occurs at Mt. Ramsay in well-formed, rather long, opaque crystals, often up to 1 inch in length, and more rarely in twins or crystalline bunches. The colour is pale-yellowish brown, sometimes with a slight greenish tinge. It is sparingly disseminated in the black amphibolite contact rock, in association with native bismuth, pyrite of various kinds, and a little purple fluorite. It is not connected with the tin ore of this locality. It is stated to occur sparingly as tabular crystals, which are nearly white, in connection with a garnet rock at the Upper Emu River. In limited quantity it occurs closely intermixed with amorphous wolframite at a locality a short distance north of Pieman River Heads, West Coast. On the south-east coast of King Island, Bass Straits, this mineral is reported to be discovered in considerable quantity intermixed with quartz, apparently in connection with a decomposed dark-brown garnet rock. The formation containing the imbedded mineral is said to be of great width, and to be about 100 feet above, and 12 chains distant from, the sea-level. The locality is about a quarter of a mile from Grassy River.

The scheelite is greenish-grey in colour, opaque and vitreous in appearance. It is irregular in deposition, often in intergrown crystalline bunches, and well-formed crystals singly and in groups are not rare, which show pyramidal hemihedrism. Nothing practical has to date been done to elucidate the geology of this find.

The following is an analysis of the roughly concentrated material, viz.:—Ca Wo_4 – 65·3 per cent., which gave Wo_3 = 52·68 per cent.; the ore contained Ta_2O_5 = 2·6 per cent. It is apparently a contact formation or lode intimately connected with the granite of the vicinity. The scheelite occurs in thin seams, with small quantities of associated molybdenite and native bismuth.

Excellent pseudomorphs, partial and occasionally complete, of this mineral to wolframite are not uncommon at a locality about 1 mile east of south of Mayne's Tin Mine, Heemskirk. They are perfect crystals in form, sometimes only transmuted to a very limited degree; then, again, the whole substance of the crystals may be changed to the iron manganese—tungstate, in which case they assume the dull surface appearance so generally typical of pseudomorphous action. Some very nice crystals of the pure substance also accompany the rest. These are from opaque to semi-transparent, and of a pale-yellowish colour. With this find wolframite also occurs in excellent crystals, both pure and partially so. For information respecting these, see notes under that mineral. A yellowish brown substance may occasionally be detected as minute blebs and veins on the scheelite in connection with this occurrence, which may be, and apparently is, the hydrated tungstic oxide, meymacite ($WO_3, 2H_2O$), which is formed by alteration. It is not of any importance, except as a mineralogical curiosity. Analysis made by Traube (Neue's Jahrb. Min. Beil. Bd. VII., 1890, p. 232), of a sample of the scheelite from Mt. Ramsay gave the following result, viz.:—

		Per cent.
WO_2	=	79·77
MO_3	=	trace
Ca O	=	19·65
		99·42
Specific gravity	=	6·09

Referring to a crystal from the same locality, Dr. Anderson remarks ("Records of the Australian Museum," Vol. VI., Part 5, 1907): "It occurs on hornblendic rock in well-formed crystals up to 1 inch in length and in crystalline bunches. The measured crystal is about 1 cm. in the direction of the vertical axis, and is grayish and semi-translucent. The faces are fairly brilliant and gave good signals; only the pyramid *e* (101) is present:—

Measured.	Calculated (Dana).
$e \wedge e' = 101 \wedge 011 = 72^\circ\ 45'$	$72^\circ\ 40\frac{1}{2}'$
$e \wedge e\ vii = 101 \wedge 0\overline{11} = 107^\circ\ 15'$	$107^\circ\ 19\frac{1}{2}'$

At Gould's Country scheelite occurs of a translucent resin-yellow colour with a crystalline surface. (W. H. Twelvetrees.)

285. SCHILLER SPAR *(Hydrated Silicate of Magnesium).*

An altered form of diallage, which is one of the monoclinic pyroxenes. It occurs at the Parson's Hood Mountain; in connection with serpentine at the Heazlewood; of foliated structure and pale-green colour in serpentine at Dundas.

286. SCHROTTERITE *(Hydrous Aluminium Silicate).*

A soft, brittle, white to honey-yellow-coloured gum-like substance, occurring as an incrustation in patches in a fissure in Silurian slate. It decomposes to a white powder. Occasionally it is stalactitic or mammillated, and easily falls to pieces. Obtained near the Pieman River.

287 SCOLECITE *(Hydrated Silicate of Alumina and Calcium).*

Occurs in oblique crystals or as acicular tufts, and sometimes of fibrous radiating structure.

A radiating zeolite, occurring in the dolerite rock of Launceston.

288. SMITHSONITE *(Carbonate of Zinc).*

Only observed in small patches on limonite, Magnet Mine.

289. SCHLEROSPATHITE *(Sulphate of Iron and Chromium).*

This substance occurs with the presumed knoxvillite at the Salisbury Mine, Blue Tier, near Beaconsfield. Like its congener it has a highly fibrous habit. It is found in large, compact, felted masses, which are extremely tough under the hammer, and comparatively heavy from contained hygroscopic water. The fibres are minute, short, and silky white. The surface is often nodular and rough from protruding fine spiculæ.

An analysis of this substance gave the following result:—

		Per cent.
SO_3	=	27·20
Fe_2O_3		14·0
Cr_2O_3	=	10·64
Loss on ignition over		39·19
Gangue	=	10·77
		101·80

Before the blowpipe the substance swells and forms a brown-coloured mass, which is easily powdered. With soda after trituration, it leaves a loose powdery residuum, which is readily attracted by the magnet. The fused mass with borax bead gives reactions of iron and chrome oxides. It is readily soluble in water, and if kept in a dry situation gives up much of its hygroscopic moisture.

290. SCORODITE *(Hydrated Arsenate of Iron).*

Formed by the decomposition of arsenopyrite, and usually found where that mineral is abundant. It is commonly met with at the Scamander River and vicinity; Golconda, Mt. Bischoff; in the cavities of siliceous skeleton rock as beautiful green crystals at the Upper Emu River; amorphous in considerable quantity at the Waterhouse goldfield, at which locality it has been obtained in green-coloured crystals in the gold mine which was known as the Southern Cross; near Mt. Pelion in quantity, the masses occasionally showing the gradual transmutation from the original arsenopyrite.

291 SENARMONTITE *(Teroxide of Antimony).*

Has occurred in small quantity at the Long Tunnel Mine, Whyte River; and at the Madame Melba Mine, North-East Dundas.

292. SERICITE *(Orthosilicate of Aluminium and Potassium).*

Occurs in foliations of rocks of schistose structure; colour, greenish to silvery white, with a silky lustre.

Abundant as sericite-schist at Mt. Lyell, Mt. Read, and other localities.

293. SERPENTINE *(Hydrated Silicate of Magnesia).*

This is in reality a rock rather than a mineral species, resulting from the metamorphism of intrusive igneous rocks, such as the ultra-basic peridotites, which are rich in olivine as a constituent. The mineral olivine is much prone to alteration, and its conversion to serpentine can be distinctly traced in rock sections, and even macroscopically. The eliminated iron from the olivine may be represented as granules of magnetite, or it may be wholly changed into the ferric state, and thence into the minerals hematite and limonite.

This mineral occurs as a rockmass of considerable extent. Its normal colour is green, of many shades, but almost every known variety of the substance, both in colour and structure, has been obtained in this island in more or less quantity. At the Heazlewood and vicinity it occurs in considerable amount, often containing a perceptible quantity of nickel silicate, which gives it a bright apple-green colour, in which case it approaches that from New Caledonia, which is worked as an ore of nickel. Along the banks of the Heazlewood River and some of the smaller streams much of the serpentine often contains large quantities of minute intensely black crystals of chrome spinel, and, more rarely, large amorphous bunches of chromite. Brucite, schiller-spar, and narrow bands of chrysotile also occur with it as accessory minerals. At Anderson's Creek and neighbourhood extensive masses of this rock exist, in many places containing asbestiform chrysotile, and steatite; north of Trial Harbour it often contains long fibrous asbestos, and is connected with an extensive bed of remarkably pure talc; also occurs at Huskisson River, Clayton Rivulet, and at the Parson's Hood Mountain. Exposures of serpentine occur on the Styx River and at the head of the Florentine. At the Serpentine Hill near the Renison Bell Tin Mine the serpentine occurs in part transmuted to an intensely black magnetite, the specimens often presenting the attractive appearance of being one-half a beautiful green serpentine, and the balance black magnetite.

294. SHALE *(Hydrocarbon).*

Argillaceous shales of a more or less bituminous character, and of various shades of brown and black, occur at several localities. They are all inflammable to some extent. So far they have not been determined.

Ben Lomond; Dilston; Beaconsfield; Karoola; George Town; Heazlewood; Blue Tier; Inglis River; Gad's Hill; and other places.

295. Siciliophite *(Silicified Serpentine).*

This peculiar altered substance is extremely variable in colour, and occasionally almost opalescent.

Near to the Long Tunnel Mine, Castray River.

296. Siderite *(Carbonate of Iron).*

Occurs of sub-crystalline structure and pale-brown colour, with quartz, both of which often contain gold, Specimen Reef Mine, Brown's Plain; in translucent masses of a vitreous appearance, rapidly weathering brown; also abundantly in the opaque form, but rarely in well-formed crystals, Mt. Bischoff; in veins, usually of lenticular form and often containing gold, Brown's Plain, Lucy River, Rocky River, and other places in the vicinity of the Pieman. This mineral appears to be the principal auriferous matrix of the locality; on the surface it is usually decomposed to the oxide. Abundant near the River Forth in compact masses; at Port Sorell it is found intermixed with quartz; in great profusion at Zeehan, Dundas, and Heazlewood, where it forms the common lode gangue of the silver-lead mines. The crystals are rarely obtained, still at the lastmentioned field they are occasionally met with, but small in size. It is more often found in the lode cavities in semi-lenticular forms aggregated together. In the Heazlewood silver-lead and adjacent mines it is commonly coloured pale-green by the admixture of the oxide of chrome.

"In the adits driven outside the main tin deposit of Mount Bischoff there occur druses of fine quartz crystals, amongst which generally appear brown saddle-shaped rhombohedra and aggregations of rhombohedra of this material. In places it occurs also massive, of a deep brown to nearly black colour" (Ulrich).

297. Siegenite *(Sulphide of Cobalt and Nickel).*

Occurs massive, of a steel-grey colour, intermixed with magnetite, pyrite, and niccolite. Rocky River Mine.

298. Sillmanite *(Anhydrous Silicate of Aluminium).*

Occurs in the form of sillmanite-schist at the Lucy River, a tributary of the Pieman, and at Mt. Stewart Heazlewood district.

299. SILVER, Native.

The free or native metal is not infrequently met with on all the silver-lead mining fields of the State, but never in large quantity. Although occasionally in arborescent patches of extreme tenuity, it more commonly affects a capillary form, varying from fine hairs to wire-like filaments. In habit it occurs in irregular tangled growths, but rarely showing any sign of crystalline structure. The surface of the metal is always somewhat discoloured by oxidation, usually yellowish to even almost black. It is invariably a secondary mineral, reduced from the state of sulphide, or deposited from salts in solution. It may reasonably be assumed that much of the capillary silver is produced from circulating solutions through the reduction of metallic sulphides. This is illustrated at the Magnet Mine, by the deposition of hair-like entangled patches of native silver nestling in the fractures and cleavages of zinc sulphide, evidently resulting from the effect of sulphuretted hydrogen. It also occurs as minute frondose branching patches in gossan at the Penguin Silver Mine, at the Murchison, at Tullah, and at several of the Zeehan mines. It occurs in the same form and under like conditions in clefts in the siliceous lode material of the Hampshire Silver Mine, where it was the principal ore of the metal; on galena in attached flaky masses, Owen Meredith Mine; in and on calcite, ankerite, and blende at the Godkin Mine, Whyte River. At this mine some exceptionally fine examples have been produced, some having arborescent clusters of microscopic crystals, and occasionally small vughs are coated and partially filled with the fibrous metal; in gossan with embolite, South Curtin and Davis Mine, Dundas. At the Hercules Mine some remarkable finds of the metal have been made, showing the wire-like filaments growing amid and embracing crystallised masses of cerussite. This occurrence was, perhaps, the finest noted in Tasmania.

300. SMALTITE *(Diarsenide of Cobalt).*

A tin-white mineral, but subject to superficial tarnish. It is fairly hard = 5·5 to 6, and has a fine-grained to uneven fracture. It is isometric in crystallisation, usually affecting the cube, octahedron, and their modifications. It is an important ore of cobalt, containing empirically from 11 to 28 per cent. of that metal, with small quantities of iron and nickel. It commonly occurs in the amorphous condition. It has been stated to occur as an almost solid vein at the North Pieman; in small quantity at the old Hampshire Silver Mine; in company with other metallic minerals at the abandoned Penguin Silver Mine; Castle Forbes Bay (Johnston, "Geology of Tasmania"); and at North Mt. Heemskirk.

301. Smectite *(Hydrous Basic Aluminium Silicate).*

This is an extremely soft substance, with a metallic, almost silvery, sheen. It easily separates into foliæ of remarkable tenuity. It is obtained in masses of almost gelatinous softness, but soon becomes harder by loss of hygroscopic moisture.

It occurs at the North Mt. Lyell Mine and at North Mt. Heemskirk.

Respecting this substance, Mr. Sticht remarks:—"The composition of this substance is not in Dana, the analyses given in the work being rather different, to such an extent that it is rather difficult to classify it as any varieties of the obscure substances mentioned in the book. Originally it was very gelatinous or glutinous, *i.e.*, thinner than gum, there being also evidently a high percentage of water in it. The humidity was great enough to allow it to be very easily moulded with the fingers, like melted wax, although it was much more transparent than that substance. It had a yellowish-green colour while moist, and an acid, astringent taste, which it still retains, and there was also some copper in the moist portion. The water-soluble part was removed before analysis, and all mechanically-contained foreign substances, like bits of quartz, &c., were likewise removed. The analysis therefore represents an attempt to get at the composition of the pure stuff itself. It was as follows:—

		Per cent.
Silica	=	46·8
Alumina	=	36·8
Calcium oxide	=	0·8
Sodium oxide	=	0·7
Potassium oxide	=	3·2
Loss on ignition	=	11·5
		99·8

The ignition loss is considered to be combined water. The loss found in drying before analysis at 100° C. was 13·10 per cent. Probably the presence of potash is exceptional. It is doubtless a decomposition product under the influence of sulphuric acid or sulphate solutions. It is not very common in the mine, and may be an unrecorded variety of halloysite."

302. SODALITE *(Chlorosilicate of Sodium and Aluminium).*

An accessory constituent in the comparatively rare alkaline series of rocks that contain nephelite (or elæolite) and minerals of that character. It belongs to the isometric system, and usually occurs crystallised in rhombic dedecahedra: it is also known massive. In colour it is invariably of a pale tint and translucent. It occurs as natrolitic pseudomorphs in the elæolite-syenite of Port Cygnet.

303. SPHALERITE *(Sulphide of Zinc).*

This common substance is more generally known on mining fields as "blende," or "zinc blende," and more rarely as "black jack." It crystallises in the cubic system, but is subject to many modifications. It has a brilliant, at times almost sub-metallic lustre, and varies from almost colourless to clear translucent yellow to pale-brown, and thence to opaque darker shades, increasing to intensely black. In common occurrence it is amorphous, with distinct cleavage. It affects an intimate association with galena, and but few occurrences of that mineral, if any, are known without more or less admixture of blende, either in the massive or crystallised form. As blende is less stable than galena in the zone of oxidation, it is the first ingredient to be attacked; and as zinc sulphate is readily soluble, and is more mobile than the lead sulphate, it is usually left behind to indicate the lead contents of a gossan. At times cadmium and iron replace portions of the zinc, and on rare occasions it may carry fair values in silver, as is the case at the Magnet Mine; while the rare elements, iridium, gallium, and thallium, are also known to occur as replacements. In the mixed lead-zinc deposits of the Mt. Read and Rosebery districts it is extremely profuse, while at the Hercules Mine very beautiful patches of remarkably well-developed but complicated crystals occur in the cleavages; they are not rarely of a clear pellucid yellow colour, and with them small crystals of galena occur. At the same mine large quantities of intensely black massive blende occur, but the major portion of the mineral is intimately mixed with the lead-sulphide in the form of diminutive grains, thus forming a solid, compact, metalliferous mass, almost devoid of gangue. It is plentiful at Zeehan in the argentiferous galena lodes, associated with quartz and the prevailing gangue mineral, siderite; occasionally druses of crystals occur of various colours, up to $\frac{3}{4}$-inch in size. The crystals are often well developed, presenting the octahedron with small planes of the cube terminating the corners. Fine octahedral twins on the spinel law are not uncommon. They sometimes vary from a resin to a greenish colour, but the prevailing tint is a shade of dark-brown. Abundant in groups and masses of amber-coloured crystals at the Mariposa and other mines at North-East Dundas. At the Silver Crown Mine at Zeehan bunches of somewhat large crystals occur of a brown colour. At the Godkin Mine, Whyte River, a richly argentiferous blende occurs in amorphous masses—it is of a mahogany-brown colour with a dull lustre. It is found associated with patches of native silver and masses of galena in a white and dark coloured calcite, and more rarely in ankerite. At the Heazlewood Silver-lead and other mines in the vicinity minute but remarkably well-formed complicated crystals are abundant. They are of a clear yellow to red colour, and are usually obtained implanted in the fractures of siderite or quartz with crystals of galenite. At the Heazlewood Mine it also occurs more rarely, in beautiful sharp-angled crystals which have a purple, green, and red metallic tarnish; abundant in a massive form of a black colour, east branch of the Hellyer River; plentifully and thickly disseminated in a vein at the Hampshire Silver Mine, where it presents a peculiar copper-red colouration; of a dark-brown to black colour with chlorophane and various forms of pyrites, Mt. Bischoff; scattered throughout a dyke formation, with galena in granite rock, Meredith Range; as minute crystals of a pale-green colour with galena, Australasian Mine, Dundas; in limited quantity, Ben Lomond; in a lode, which is mainly composed of a mixture of this mineral, arsenopyrite, and galena, Scamander River; Penguin River Silver-lead Mine; Mt. Claude; Middlesex, with pyrites and galena; often highly auriferous, but in very small quantity, Lefroy and Mathinna. A peculiar variety of phosphorescent blende occurs at the Castray River; it was obtained in trenching across a decomposed lode formation as rounded lumps, brown in colour, and of small size, with masses of galena and pyrites as accessory minerals. The phosphorescent character is clearly distinct when the material is struck or scraped with a knife-blade. It is locally known as "electric calamine." At the Hercules Mine a comparatively small portion of the massive zinc sulphide shows strong evidence of decomposition, the mass becoming much softer in consequence; on the faces of fractures and on the walls of cavities in this partially-altered ore are sparingly scattered small spangles of an extremely thin white mineral which has a highly glistening lustre, and which, from its physical characters, would appear to be zincaluminite, but the scales of the attached substance are so extremely thin that it is difficult to secure sufficient for a satisfactory qualitative test.

"Sphalerite is often found well crystallised in the Zeehan district. Some of the crystals in the western portion of that field (Comstock) are well formed, consisting of supplementary tetrahedra, so that perfect smooth-faced octahedra result occasionally. In other cases the tetrahedral faces are striated in the characteristic manner. Simple twins occur in which the twinning-plane and combination-plane are identical with a tetrahedron face. In such cases as those in which equally-developed supplementary tetrahedra are twinned according to this law, the resultant twin crystal closely resembles one of the characteristic twins of a mineral in the spinel group. These crystals of the Comstock district are black and opaque. . . . . On the Silver King-Bell line of lode at Zeehan the vein-matter often carried massive ruby and resin blende, and occasionally crystals occur in the vughs. These crystals, usually brown in colour, are not so perfectly developed as those of the Comstock district. . . . To the north of Zeehan, in the area drained by Parting Creek, there is a notable development of sphalerite crystals which are almost invariably pale in colour—from yellowish-brown to yellow. These crystals are highly complex forms and are often distorted." (L. K. Ward.)

Dr. C. Anderson, M.A., D.Sc. (Edin.), has supplied the following notes upon some rare sporadic sphalerite crystals which were obtained at the Heazlewood Silver-lead Mine:—

"The crystals measure up to ·8 cm. in diameter, and have a brilliant, almost metallic, lustre on some of the faces. They are accompanied by siderite in sharp-edged crystals. The largest crystal was measured on the goniometer, and found to be a complex quartet, consisting of one large individual with three smaller ones twinned on different tetrahedron faces, and partly in juxtaposition, partly inter-penetrating. The forms are *a* (100), *d* (110), *o* $(1\bar{1}1)$, *m* $(\bar{1}13)$, q_1 (331); in addition there are certain dull planes not admitting of exact angular measurement, but which seem to belong to β_1 $(5\bar{2}2)$. The largest faces belong to *o*, here taken as the positive tetrahedron; they are slightly striated parallel to their intersections with *m*. The faces of *a*, *o*, *m* are bright, of *d* less so; *q* is mostly dull."

These beautiful and interesting examples of crystallization occur in small vughs implanted on crystalline siderite, associated with steinmannite and yellow translucent crystals of sphalerite of the normal character. They are of extreme rarity and exquisite development, although usually small in size.

304. SPHENE *(Titanate and Silicate of Calcium).*

This mineral is also known as titanite. It is an abundant accessory in various igneous rocks, and is of some petrographical importance, and of interest to the mineralogist, when in macroscopical crystals. The large crystals have been used as gems, after passing through the lapidary's hands; but that is quite exceptional. It occurs frequently in small, dark-yellow to brown, ill-formed tabular crystals of resinous lustre in the amphibolite of Mt. Ramsay; generally in specimens showing both scheelite and ilmenite. At first glance it might be mistaken for the much rarer axinite, but on trial before the blowpipe it imparts no colour to the flame, and the microcosmic salt bead light-yellow in the oxidation flame turns to the—for titanic oxide—characteristic violet colour in the reduction flame. In small wedge-shaped crystals in the alkali and elæolite syenite of the Port Cygnet complex; abundant as microscopic crystals and particles in hornblende granite from the vicinity of the Heazlewood River; common accessory ingredient in the rock from the Parson's Hood Mountain.

This mineral decomposes to a white, earthy titanite, which is known as leucoxene, and is abundant in microsections of many igneous rocks.

305. SPINEL BLACK. (See PLEONASTE.)

306. SPHEROSIDERITE *(Carbonate of Iron).*

This form of iron carbonate is peculiar to amygdaloidal basalt, in which it occurs in globular concretions of variable size; it is usually solid, but may be in tiers or scales, with an invariable fibrous structure. It is in various shades of brown, from pale to dark. As occurring in this State it rarely exceeds an inch in diameter of the globules. It is commonly mistaken for a form of zeolite, or even for ferrocalcite, to which latter it is closely allied. It is abundant in the vescicles of the basalt at Rouse's Camp, near Waratah; at the railway bridge which spans the Hellyer-road; and also in less profusion in the basalt at Springfield.

307. STANNITE *(Sulphide of Iron, Copper, and Tin).*

This somewhat uncommon mineral was first obtained in this island at what was known as Clark's, or No. 1, Tribute, Silver Queen Mine, Zeehan, and apparently occurred in considerable abundance intermixed with galena, chalcopyrite, and pyrite. Many assays proved it to contain about 90 oz. of silver with approximately 3 dwt. of gold per ton. Many of the samples appeared to merge into chalcopyrite on the one hand, and into ordinary iron pyrite on the other. It is mined at the Oonah S.M. Company's property, Zeehan, somewhat extensively, the occurrence being in many respects parallel with the occurrence at the Conrad Mine, Howell, New South Wales. It does not occur either at Zeehan or at its New South Wales locality in a crystallised state; but it has been obtained at its classic locality, Cornwall, England, where it is also known as "bell metal ore," in a crystalline condition or showing imperfect crystals. More recently well crystallised examples have been obtained at Oruro, Bolivia. It has been found that the species belongs to the tetragonal system, and presents forms closely related to those of copper pyrites. In Cornwall an extremely rare silicate containing tin and calcium, stokesite, crystallising in the orthorhombic system, has been obtained at St. Just's. It may not be out of place to note that stannite occurs in Bolivia in close company with four interesting sulphides peculiar to that country, viz:—cylindrite (Pb_6 Sb_2 Sn_6 S_{21}), canfieldite (Ag_8 (Su & Ge) S_6), franckeite (Pb_5 Sb_2 Sn_2 S_{12}), and teallite (Pb Sn S_2). None of these rarer tin-bearing species of minerals have so far been detected in Tasmania, but as they are found associated with the stannite in the localities mentioned, it would not be surprising if some of, or analagous forms to, these minerals should be discovered.

308. STICHTITE *(Carbonatohydrate of Magnesium, Chrome, and Iron).*

This is beyond doubt an unrecorded mineral species which has hitherto been known under the name of kammererite, and is referred to by the writer under that appellation in the "Catalogue of the Minerals of Tasmania," 1896. A specimen was exhibited by Messrs. Stitt and Cullingsworth at the Tasmanian Exhibition held in Launceston in 1891, and named by these gentlemen kammererite, which term has been retained until the present time. This error was doubtless caused through its remarkable similarity to the mineral indicated, both as regards colour and general physical characters, a resemblance so close, in fact, as to be readily excusable, since the supposed identity was made out without a complete analysis. It has been aptly referred to by Mr. R. Sticht in a letter to the writer as "masquerading under the name of a massive form of kammererite." The writer has great pleasure in dedicating this new mineral species to Mr. Robert Sticht, the well known and able general manager of the Mt. Lyell Mining and Railway Company, who has rendered material assistance in the production of this Catalogue. At the same time it is necessary to state that its detection as a substance of special interest is due to Mr. A. S. Wesley, the chief chemist to the Mt. Lyell Company, who, by the analyses now published of a portion of a specimen contained in his mineral cabinet, and by subsequent research, established its specific distinction from any mineral species hitherto described.

It is related, and may be said to belong, to the genus pyroaurite ($R_2''' O_3$, $6Mg O$, $C O_2$, $A3 H_2 O$), the greater portion of the $Fe_2 O_3$ being replaced by $Cr_2 O_3$, or otherwise a carbonato-hydrate of Mg, Cr, and Fe, developed from the alteration of the numberless minute chromite crystals and particles in the presence of serpentine.

An analysis gave the following result:—

		Per cent.
$Cr_2 O_3$	=	11·5
$Fe_2 O_3$	=	9·0
$Mg O$	=	36·0
$C O_2$	=	7·2
$H_2 O$	=	36·1
		99·8

(R. Sticht.)

Answering to the formula $(Cr Fe_2) O_3$, $6Mg O$, Co_2 $13 H_2 O$, in which $Cr_2 O_3 : Fe_2 O_3 =$ approximately 3 : 2. Hardness = 1·5. Specific gravity (determined by Mr. L. K. Ward) = 2·20; that of a second and almost pure example (that is, with only two or three small specks of yellow-green serpentine) = 2·12.

At the same time the specific gravity is desirable of an absolutely clear and fresh specimen. The streak is a very pale lilac to almost white. Its wet chemical reactions are that it is soluble in HCl with effervescence, which is very brisk when the acid is heated. It affords an intensely bright-green solution with a limited flocculent turbidity as a precipitate. The pyrognostic characteristics are that it assumes a bronze colour when heated on coal, and then becomes perceptibly magnetic.

This new species of mineral is only known to occur in the amorphous condition. It may be foliated to compact, and is not rarely granular. Its colour is a most beautiful and intense lilac shade, and is thus of considerable attractiveness. In respect of colouration it stands alone amongst the minerals of this State. It weathers on exposed surfaces to a brown tint, and is considerably roughened by numerous slightly protruding fragments of partially decomposed chromite. The smaller samples of the stichtite often have as a nucleus one or more minute fragments of the chromite, which thus to an extent reveal its origin. In habit it forms irregularly-shaped masses, veins, and blebs in a pale yellowish-green serpentine, more rarely showing ill-defined bands of the new mineral. At times the serpentine is irregularly speckled with patches of lilac-coloured stichtite, which vary in size from extremely minute to 10 or 12 mm., and then form mineral specimens of a unique character and peculiar beauty, the green of the serpentine contrasting strongly and favourably with the lilac stichtite.

Mr. L. K. Ward, who recently visited the locality of this interesting discovery, has kindly supplied the following note:—

"This mineral forms irregularly-shaped masses, veins, and blebs in serpentine at Dundas, in the neighbourhood of the Adelaide Mine. Weathered surfaces are deep-brown, but the fresh mineral varies in colour from lilac or rose-pink to deep-purple. It is at this place usually associated with crystalline chromite. The chromite crystals appear to have in many cases served as nuclei, about which the stichtite has developed. Its distribution is sporadic. Microscopically it appears to be built up of radiating plates and tufts.

Optical Properties in Thin Section.

Colour—Pale-rose to brownish-rose.

Pleochroism—Absent.

Birefringence—Strong, giving 2nd to 3rd order colours, in section not exceeding 0·03 mm. in thickness.

Extinction of Fibres—Straight.

Optical Character (measured with respect to the elongation of the fibres)—Positive.

Structure—Fibres and tufts, sometimes curved, radially disposed about nuclei of chromite. The radiating aggregates are wrapped round with a mosaic of small scales and fibres.

"NOTE.—Optical properties require further investigation. Only one thin section available for examination."

309. STEARGILLITE *(Hydrous Basic Silicate of Aluminium).*

An unsatisfactory clay-like mineral that is apparently allied to the above occurs in the vicinity of Derby. It is a pale-yellow, almost white, substance, with a strongly conchoidal fracture, and slightly opalescent, smooth surface.

310 STEATITE *(Hydrated Silicate of Magnesium).*

This is more generally known as soapstone. It is the massive variety of talc, with a characteristic soft unctuous feel, and is so soft that it yields to the nail. It is first in the scale of hardness. It is a very abundant substance, and is useful for many minor industrial purposes.

It is abundant in connection with serpentine, Asbestos Mountain; also known to occur at the following, among other places:—Mt. Bischoff; Heazlewood; Mt. Claude; and near Beaconsfield.

311. STEPHANITE *(Sulphide of Silver and Antimony).*

This well-marked species is orthorhombic in crystallisation, occurring either as short prisms or as tabular crystals, which are often mackled, but is commonly massive or in clusters. It is soft and sectile. Known also as brittle silver ore. It is black and dull in appearance, with a black streak. It is found in thin irregular patches, implanted on a siliceous gangue, often in company with "fire blende," at the Long Tunnel Mine, Castray River; it has also occurred at the Owen Meredith Mine implanted on galena; and has been reported as occurring at the old Scamander Silver Mine.

312. Steinmannite *(Sulphide of Lead and Antimony).*

What is apparently this mineral occurs in small but perfectly developed octahedral crystals of a tin-white colour and bright lustre. They range from 1 to 5 millimetres in diameter. In habit they are found singly or in bunches of three or four crystals implanted in cavities of the green-stained dolomitic gangue, and more rarely as small reniform masses, the surfaces of which are often studded with well-formed crystals. In the druses they are usually accompanied by bright little yellow crystals of sphalerite, and equally well-developed crystals of quartz Before the blowpipe on coal they give unmistakable reactions for lead and antimony.

So far these crystals have only been detected in the workings of the Heazlewood Silver-lead Mine.

313. Sternbergite *(Sulphide of Silver and Iron).*

A rare silver ore that belongs to the orthorhombic system. The crystals are thick, tabular, but more often they occur as thin plates. The lustre is metallic, but commonly much tarnished.

The only known occurrence in this State was at what was known as the Godkin Extended Mine, where it was found in close association with huascolite and galena.

314. Stilbite *(Hydrated Silicate of Aluminium and Calcium).*

This mineral has occurred, with other zeolites, as a somewhat finely divergent mass of a yellow-brown colour in the amygdaloidal basalt in the vicinity of Bell Mount, Middlesex. Its common mode of occurrence is in diverging and radiating groups, the prisms of which are not rarely several inches in length. In crystallisation it is monoclinic. The crystals are often in the form of cruciform penetration twins.

315. Stibiconite *(Hydrous Oxide of Antimony).*

A pale pulverulent mineral which occurs in amorphous earthy masses. It has occurred in small quantity at the British-Zeehan Mine, Zeehan.

316. STIBNITE *(Sulphide of Antimony).*

This is the principal commercial ore of antimony, a metal which, with arsenic and bismuth, forms an alliance of brittle metals. It is usually found massive, with a distinctly bladed habit, is very brittle, and may be mistaken for bismuth sulphide. It crystallises in the orthorhombic system. It may be recognised by its perfect longitudinal cleavage and by horizontal lines on the cleavage surface.

It has occurred in massive irregular bunches of considerable size in quartz reefs at Lefroy, with the usual columnar structure, notably at what was known as the Orlando Gold Mine. It did not carry the precious metal to any appreciable extent. In very limited quantity near Mt. Claude; in schist in apparently fair quantity at Port Davey; as a lode at Hall's Creek, near Lynchford, of very fair quality; found as a diminutive vein at Rosebery. Reported to occur at Mt. Bischoff and North-East Dundas, but in both instances the antimonial mineral was not stibnite.

317. STILPHNOSIDERITE *(Hydrated Peroxide of Iron).*

Occurs of a dark blackish-brown colour, with a conchoidal fracture, shining and brittle. It is generally found in a stalactitic form, or as a varnish-like coating on limonite or manganese minerals, more particularly on psilomelane.

Central Dundas Mine; rarely, Mt. Bischoff; lining vughs of ironstone with cuprite, Mt. Lyell; Central Balstrup Mine, Zeehan, coating masses of limonite, which are commonly of stalactitic form.

318. STRIGOVITE *(A Basic Silicate of Iron and Aluminium).*

A chlorite-like mineral, consisting of a black shining aggregate of minute plates, in the fractures decomposed to brown. Occurs as a narrow band a few inches wide in granite near the Great Republic Tin Mine, Ben Lomond

319. STROMEYERITE *(Sulphide of Silver and Copper).*

When pure this mineral contains about 52 per cent. of metallic silver. It crystallises in the rhombic system, and is isomorphous with copper glance. In colour it is steel-grey, with a metallic lustre and shining streak. It is soft and perfectly sectile. It occurs disseminated, with bornite and chalcopyrite, in a quartz matrix at Mt. Lyell. Assays of the mixed material have given returns at the rate of several thousand ounces of silver to the ton of ore. It is reported to occur on the footwall of the extensive interbedded formation of cupriferous pyrites for which the locality is now well known.

Analysis of an amorphous slug from the Mt. Lyell Mine: —

Per cent.
Ag = 13·80 = 4507 oz. 19 dwt. 23 gr. per ton.
Pb = 1·60
Cu = 32·46
As = 3·17
Sb = trace
Fe = 19·26
S = 38·27

98·66

320. STRONTIANITE *(Carbonate of Strontium).*

Found in small veins and pockets, usually of a white satiny appearance, at the Hampshire Silver Mine (W. R. Bell). This substance is not known to occur at any other locality in the island. It was obtained irregularly mixed up with lode-matter, with fluorspar, apatite, and several minerals, which, like it, are almost peculiar to this interesting locality.

321. SULPHUR, Native.

The decomposition of pyrite gives rise in some cases to the elimination of native sulphur, as has been the case in portions of the Bischoff Tin Mine. It is an extremely rare substance in Tasmania; the occurrence mentioned being the only instance affording an appreciable quantity. It occurs as a powdery mass intermixed with pulverulent quartz resembling geyserite at the south-western face of that portion of the mine known as the "Brown Face," and is naturally in close association with masses of iron pyrites, which occur more or less underlying a highly ferruginous crust, which probably originated through the alteration of the pyrite. It has been detected in small quantity as extremely minute microscopic crystals encrusting the fractures of galena of several of the mines at Zeehan.

322. SYMPLESITE *(Hydrous Iron Arsenate).*

A rare mineral that has only occurred at the Magnet Mine. It is monoclinic in crystallisation and prismatic in habit, with the faces vertically striated. It occurs thickly coating cavities in the harder ferro-manganese gossan as small radiating blue-green tufts packed, in many instances, closely together, and covering fairly large surfaces. Under the lens it is a mineral of considerable attractiveness

323. TALC *(Hydrated Silicate of Magnesium).*

A beautiful snow-white form occurs at the Arthur River near its junction with the Hellyer. On the west branch of the Clayton Rivulet this mineral occurs as a vein of a yellowish-white colour, and is about 2 feet in width. About 1 mile north of Reminé, on the coast, a beautiful semi-transparent form exists in considerable abundance; it abuts upon the serpentine outcrop; it varies in colour from translucent white to a clear pale-green. A large formation occurs on the Meredith Range, near the Castray River; it is massive, compact in structure, and very pure; the prevailing colour is a beautiful pale sea-green, shining, and extremely unctuous. Of subcrystalline structure in large masses, Magnet Range; in radiating masses with cassiterite, North Valley, as well as impure and massive at other places at or near Mt. Bischoff; Asbestos Mountain, near Beaconsfield; near the Parson's Hood Mountain; Ben Lomond; Blue Tier.

324. TASMANITE *(Hydrocarbon).*

A grey, earthy, arenaceous shale, more or less impregnated with circular, punctuate, brown, microscopic fossil spore cases of a highly resinous nature, which have been named Tasmanites punctatus (Newton).

The spores yield an oily product in considerable quantity, but of poor illuminatory power. As much as 100 gallons of oil has been obtained by distillation per ton of shale. In beds of considerable extent on the banks of the Mersey River.

The American black paraffin shale has been found to be extremely rich in spore cases of a similar structure and character to those so abundant in tasmanite. The origin of the shale is supposed by some authorities to have been the accumulation of the shell spores of a species of marine algæ, similar to that now existing in the Saragossa Sea.

Dana states ("A Textbook of Mineralogy") that this hydro-carbonaceous substance is "remarkable in containing sulphur, replacing part of the oxygen."

An analysis by Professor Penny (Pro. Roy. Soc. Tas., 1855) gave the following results:—

			Per cent.
Volatile matters		=	20·41
Coke	Fixed carbon	=	5·50
	Ash	=	71·20
Sulphur		=	·73
Water		=	2·16
			100·00

Collins, in his "Mineralogy," gives the following analysis:—"Carbon, 79·34; hydrogen, 10·41; oxygen, 4·93; sulphur, 4·93; after rejecting 8·14 per cent. of ash, or agreeing closely with succinite, in which part of the oxygen is replaced by sulphur. Burns readily, with a smoky flame and disagreeable odour; fuses partially, yielding oily and solid products; not dissolved by ether, alcohol, benzine, oil of turpentine, or bisulphide of carbon; not acted on by $H\,Cl$; slowly oxidised by HNO_3; readily carbonised by H_2SO_4 with evolution of H_2S."

The tasmanite oil shale which occurs over a considerable area in the basin of the Mersey River, near the township of Latrobe, has from its unique features received considerable attention from the scientific aspect of its probable origin, as well as from its oil-producing properties, although it has not so far become of any economic importance. The seams of tasmanite occur just below the upper marine Permo-Carboniferous beds associated with the sandstone of the area, and thus approximately correspond with the Mersey coal measures, although the precise relation with the coal seam has not yet been exactly correlated. Many species of marine Permo-Carboniferous fossils are recorded from the beds, such as productus, sperifers, cardiamorpha, pachydomus, and pleurotomaria. The shale-bearing area is approximately about 6 miles long by 2 miles in width, and lies east of the railway-line between the townships of Latrobe on the north and Railton to the south. The seams, of which there are apparently several, vary in thickness up to as much as 9 feet. The shale itself presents a pale-brown coloured, fine-grained sandstone, occasionally with irregularly scattered larger particles, and more rarely casts and impressions of pleurotomaria and other fossils, the whole being closely packed with very minute flat discs, which are evidently charged with the oily substance. It readily ignites from the flame of a match, burning with a yellow flame, giving off much dark-coloured smoke, and emitting a strong pungent odour.

In 1902 a syndicate originating in South Australia carried out some exhaustive experiments under the direction of Dr. J. G. Black, M.A., D.Sc., Lecturer in Chemistry at the University of Dunedin, New Zealand, and Mr. Thomas Esdaile, A.O.S.M., late Lecturer in Chemistry at the Adelaide School of Mines, with apparently highly satisfactory results. The shale from various outcrops is reported to have given from 44 to 65 gallons of crude heavy oil per ton. This material was of an extremely dark colour and viscid character. It has been represented that the sulphur and refractory bitumens were removed without difficulty, and thus formed no obstacle to the successful distillation of the viscid crude oil. The average return of oil from the shale has been given as 60·2 gallons per ton, with a specific gravity of 0·932, as against 0·892 of the oil from the well-known Scotch shales. Various grades of lubricating oils which are said to be of commercial use for specific purposes were obtained by Mr. Esdaile by fractional distillation; the final results showing a total of 64 per cent. lubricating oils, 25 per cent. lighting oil, and 11 per cent. benzine and benzoline. It was reported that 1 ton of the shale yielded as much crude oil in these experiments as 2½ tons of the Scotch shale. Mr. Thomas Esdaile, A.O.S.M., also states that the following shale by-products could be produced if working on a large scale, viz.:—

(1) *Residues*—
- Knife polish in various grades.
- Brasque bricks.
- Firebrick material.

(2) *Refinery By-products*—
- Sludge oils, saleable for rope oils.
- Bases for manufacture of dyes.
- Cresols.
- Drugs for certain purposes for which valuable applications have already been found.
- Substitutes for linseed oil in making certain kinds of paints.
- Oils suitable for making certain useful cementing materials by reason of their power of combining with various metallic hydroxides.

(3) *Refinery and Distillation Sludge Waters*—
- Ammoniacal bases for making sulphate of ammonia.
- Several organic acids (which require further investigation).

(4) *The Pitchy Residues*—
- Vaseline and heavy oils.
- Anthracenes.
- Valuable mineral waxes.

"Japan" black suitable for giving a lustrous black coating to wood or iron work.

In the Mersey petroleum, compared with other petroleums, there are:—

(1) A very much greater proportion of heavy viscous oils suitable for lubricating oils.
(2) A greater proportion of the higher hydrocarbons.
(3) A greater proportion of nitrogenised bodies, from some of which azo-colouring matters and other valuable by-products will be obtained.
(4) A larger proportion of olefines and napthenes in the oils.

325 TENNANTITE *(Sulpharsenide of Copper and Iron).*

A variety of fahl-ore containing As. It is dark in colour, inclining to iron-black; lustre opaque, metallic; and has a brittle, uneven fracture. "The arsenical variety (of fahl-ore) is also found at Mt. Lyell, in the rich secondary vein in the Mt. Lyell Mine, associated with bornite, stromeyerite, and chalcopyrite." (R. Sticht.)

Analysis of a sample from No. 4 adit, Mt. Lyell Mine:—

		Per cent.
Ag	=	0·54
Cu	=	16·17
As	=	13·82
Sb	=	17·10
Fe	=	16·39
S	=	30·77
		94·79

Respecting the occurrence of this mineral at Mt. Lyell Mr. R. Sticht supplies the following notes:—"This occurs in the Mt. Lyell open-cut in the heart of the ore-body, and appears to be contaminated with a little iron pyrites or copper pyrites. The general analysis was as follows:—

		Per cent.
Insoluble residue, *i.e.*, silica	=	0·15
Iron	=	3·05
Copper	=	41·4
Zinc	=	6·5
Arsenic	=	16·55
Sulphur	=	28·3
Antimony	=	0·35
Calcium oxide	=	0·3
		96·6

The difference from 100 per cent. is surmised to be water or moisture. However, the sample analysed was dried at

100° C. Discarding the solubles and traces of antimony and lime, it would appear that this mineral, *per se*, has the following composition:—

Per cent.
Iron pyrites ($Fe\ S_2$) = 6·82
Copper = 43·21
Arsenic = 17·28
Sulphur = 25·91
Zinc = 6·79
100·01

This separation is on the assumption that the pyritic mineral which is visible in the mass with the ordinary glass is chiefly iron pyrites. The appearance of it, however, would lead one to think that it was at least cupriferous, if not straight chalcopyrite. However, right through the larger specimen there is a flat vein ¼-inch thick of solid iron pyrites, associated with a very little chalcopyrite. Abiding by the assumption that the main foreign material is iron pyrites as above, the composition, *per se*, of the pure mineral would be:—

Per cent.
Copper = 46·36
Arsenic = 18·55
Sulphur = 27·80
Zinc = 7·29
100·00

Now, taking the original analysis, and dividing by the atomic weights to get the number of atoms present, we find the following:—

Atoms.
Copper = 12
Iron = 1
Arsenic = 4
Sulphur = 16
Zinc = 2

This corresponds to a percentage composition as follows:—

Per cent.
Copper = 43·34
Iron = 3·19
Arsenic = 17·07
Sulphur = 29·12
Zinc = 7·28
100·10

and a formula as follows:—

$$Fe\ S_2\ (6Cu_2\ S + Zn\ S2\ As_2\ S_3 \quad \text{or}$$
$$Fe\ S_2\ [4\ (Cu_2\ Zn)\ S\ As_2\ S_3]$$

The percentage composition of the mineral mixture is then 6·84 per cent. $Fe\,S_2$ and 93·16 per cent. of a mineral containing—

		Per cent.
Copper	=	46·52
Arsenic	=	16·32
Sulphur	=	27·34
Zinc	=	7·82
		100·00

This last composition is that of the tennantite portion of the above formula, and corresponds remarkably closely with the percentage composition derived from the original analysis, on the assumption that the only impurity in the mineral is iron pyrites. In other words, the mineral is a zinciferous tennantite, and the name of kupfer-blende probably correctly applies to it.

" Analysis of a second sample:—

		Per cent.
Insoluble residue	=	0·2
Cu	=	41·0
Fe	=	4·34
As	=	17·63
S	=	26·96
Zn	=	5·6
Sb	=	0·24
Ca O	=	0·2
Not determined	=	3·83
		100·00

The undetermined is probably H_2O, as the water was not driven off at 100° C." (R. Sticht.)

326. TENORITE. (See MELACONITE.)

327. TEPHROITE *(Orthosilicate of Manganese).*

Occurs in crystallised masses of a dark reddish-brown colour and greasy lustre. Blythe River.

328. TETRAHEDRITE *(Sulphide of Copper, Antimony, &c.).*

This mineral is also known as grey copper ore, and as "fahl." The latter is the common appellation in Tasmanian mining fields, but the term is rather ambiguous, as it is indiscriminately applied to ores with the general characteristics of this mineral. It is isometric in crystallisation, with all the habit of the regular tetrahedron which the crystals usually present. The regular tetrahedron is commonly levelled on the edges by planes of the three-faced tetrahedron.

Although tetrahedrite may be essentially a sulphantimonite of copper, the copper may be partially replaced by zinc, iron, or silver, whilst the antimony may be replaced by arsenic. When isomorphous silver is present, the ore is known as freibergite, and when much arsenic has replaced the antimony it is known as tennantite. Mercury and bismuth may also be present in limited quantity. As occurring in this island, fahl ore is justly noted for the somewhat unusually large returns of silver it gives on assay; this remark applies to its occurrence at all the mining localities. It is not only an important ore of silver on account of the high value for that metal, but also from the established fact that it has been proved to live to great depths, as has been shown by the deep levels of the more celebrated mines of Saxony. At the Western Mine, Zeehan, it was obtained in beautifully bright, well-formed crystals, extremely rich in silver, from the deepest workings. A small quantity was obtained intermixed with pyrite at the old Penguin Silver Mine; at the Long Tunnel Mine, Heazlewood, it has been found intermixed with sphalerite, galena, and jamesonite; at Mt. Lyell it occurred in close association with cupriferous pyrites, and afforded remarkably high returns for silver, and also for gold; at the Hercules and adjacent mines at Mt. Read it occurs in limited quantity, often assaying at the rate of 2000 to 3000 oz. of silver per ton, and at the mine named nice patches of crystals have been obtained; at the South Curtin and Davis and other mines at North-East Dundas it is commonly associated with bladed bismuthinite. Crystals are occasionally found, but they are by no means abundant. In the Zeehan silver-lead mining field it very often occurs sparingly, accompanying galena and pyrites, sometimes in the form of crystals implanted on brownish siderite. The Oonah Mine has afforded some fairly good crystal groups. It is the staple form of nearly all the product of the North-East Dundas silver mines, very commonly occurring, as at the Ring Valley and Curtin-Davis Mines, as an amorphous lode-mineral, with siderite as the prevailing gangue. In the majority of cases it is remarkable for its consistent purity and satisfactory silver contents.

Variety—*Freibergite.*

Analysis of a pure sample from the Hercules Mine, Mt. Read:—

Ag = 9·82 per cent. = 3201·32 ozs. per ton
Au = ·0019 " = 13 dwts. "
Cu = 29·76
As = 2·69
Fe = 4·56
S = 27·21

94·7319

Balance, insoluble matter.

329. THOMSONITE *(Hydrated Silicate of Aluminium and Calcium).*

A zeolitic mineral occurring in basalt rock, Sheffield, in small vughs, but the identification is somewhat doubtful, as the samples are small and indistinct; occurs in clusters of microscopic crystals, which are of a yellow colour, coating the clefts of lode material.

Hampshire Silver Mine, Hampshire Hills. In bunches of white capillary fibres coating vughs in the nephelinite of the Shannon Tier.

330. TOPAZ *(Fluosilicate of Aluminium).*

This mineral crystallises in the orthorhombic system. The crystals have a distinct and characteristic habit, the prisms being always striated longitudinally, with a perfect basal cleavage. They affect very pale tints, ranging from water-clear colourless gems to pale-blue, and thence to a sea-green shade. A cursory inspection might give the impression of quartz, but the form of crystal, cleavage, and striation is very distinct and characteristic. Topaz is also harder than quartz, coming next in the scale of hardness to sapphire. It is an accessory mineral in the granitic rocks, and may in some cases be an original constituent. In the majority of occurrences it is of secondary origin, resulting usually from the alteration of felspar; it is therefore presumed to be of pneumatolytic origin. It has been shown by Penfield and Minor ("On the Chemical Composition and Related Physical Properties of Topaz," American Journ. of Science, Vol. XLII., p. 387, 1894) that the fluorine constituent in the mineral may be partially replaced by hydroxyl. Such a medium as hydrofluoric acid may be able, under favourable conditions, to effect the conversion of felspar to topaz. Although topaz may be of secondary origin, it may lend itself to decomposition, and then pass into kaolin, micaceous minerals, or prosopite, with which latter mineral it is not uncommonly associated. It is obtained at several of the tin-mining districts of the island, "of the finest water, and of a brilliancy scarcely inferior to the diamond" (Bristow "Glossary of Mineralogy," 1861, p. 383). It is found of all sizes. Specimens have been obtained nearly 8 inches in length, and of perfect transparency. At Killiekrankie Bay, on the west side of Flinders Island, it occurs in great profusion, both as waterworn pebbles, and more rarely in fine, well-defined, clearly-cut crystal forms. It occurs in stanniferous alluvial drift, resulting from the detrital granite rock. Several other minerals are common with it, including quartz, zircon, and black tourmaline. The topaz is but rarely found *in sitû*; it occurs in fissures and vughs associated with crystals of felspar and quartz. The late C. Gould, at one time Government Geologist (Pro. Roy. Soc. Tas., 1871, p. 60) wrote that the topaz originated from pegmatite bands, varying in width from 1 to several feet, composed of the ordinary Tertiary granite minerals highly magnified, the size of the individual minerals being enormously increased, so that the blocks of felspar, quartz, and even mica, occur up to several feet in dimension. These appear to be the scene of the most abundant source of the topazes, which have crystallised out into natural cavities, from whence they have been delivered by erosion." At Mt. Cameron and vicinity they are abundant, although generally much waterworn, in the alluvial tin workings. They occur more or less abundantly all through the north-eastern tin-producing districts, Thomas' Plain, Moorina, and the Weld River being noted localities. At Bell Mount and vicinity, in the Middlesex district, topaz has been obtained somewhat abundantly, both *in sitû* and in the tin drift. The samples obtained in the porphyritic rock are usually beautifully crystallised, with bright well-cut facets. They often occur in bunches and groups interspersed with the tin crystals. They are not in this locality so large as many found in the vicinity of Mt. Cameron or at Flinders Island. At the Shepherd and Murphy Mine they occur in the lode-filling in close association with bismuthinite, cassiterite, and wolframite, with abundance of highly coloured fluorite and green talcose spodumene. In the granitic alluvial wash of the Stanley River tinfield topazes with sapphires are sometimes found, together with tin ore, and there is a great deal of monazite with them in the form of heavy yellow sand. At Long and Brown Plains, between the Heazlewood and the Pieman Rivers, small glassy particles and ill-formed crystals of the mineral occur in the sandy drift of the watercourses. Topaz is not now much in request for the jeweller's art, but the stone as occurring in this State is not rarely seen cut and mounted. The crystals have been described by Dr. C. Anderson, M.A. ("Records of the Australian Museum," Vol. VI., Part 2, 1905), who states, "At Mt. Cameron topaz is abundant in the stanniferous drift, but has not been found *in situ*. It is usually much worn, but some crystals well suited for crystallographic determination were sent to me by Mr. Petterd. Two crystals were determined in the goniometer, one a crystal measuring 12 mm. It is fairly rich in prism faces, having *m* (110), *M* (230), *V* (120), and *q* (130) present; *V* predominates, but all are well marked faces, and give fairly good images. The terminal faces are rather dull, only one face of *O* (221) is present.

"From another lot of small, clear, colourless crystals one was selected and its face determined. It measures 7 mm. × 5 mm. × 5 mm., and in general habit resembles the last, but has fewer prism faces, and has the rather rare pyramid *x* (243) fairly well developed, but dull. The prism faces are striated, and give only fair signals."

Referring to the topaz from Flinders Island, the same mineralogist writes, "Topaz from Flinders Island was first mentioned, I believe, by the late Rev. J. J. Bleasdale, D.D., who wrote:—'This may be said of these (*i.e.*, topaz crystals) from Flinders Island, that they possess very great fire and beauty when cut, and are nearly all of a pale-yellowish shade in the rough.'"

The best account of the occurrence is that of the late C. Gould, Government Geologist of Tasmania, who observed it whilst making a geological reconnaisance of the islands in Bass Straits (Pro. Roy. Soc. Tas., 1871, 1872, pp. 60, 61). The following paragraph gives an abstract of his observations:—"It occurs in crystals and pebbles in great variety of form, colour, and size, associated with zircon, tourmaline, cassiterite, &c. It is derived from the granite, and may occasionally be obtained in fine crystals *in situ* along with crystallised quartz and felspar. It is abundant on the north-east side of Killikrankie Bay in a creek descending from the ranges, and upon the beach. It also occurs in other parts of Flinders Island. The topaz has evidently been formed in veins of pegmatite, which traverse the granite, and vary from 1 to several feet in diameter The colour varies from pure limpid to various shades of blue, pale-pink, yellow, &c. Crystals are found up to several inches in diameter. A fine crystal measuring 7 mm. × 9 mm. × 7 mm., and perfectly clear and colourless, was measured on the goniometer. As the faces are very irregularly developed and one side of the crystal is broken, the crystal is drawn in ideal symmetry, but so as to show the habit as nearly as possible. The prisms *m* (110) and *v* (120) are about equal in size and striated, but the images are good. The brachydomes *f* (021) and *y* (041) are relatively small, while the macrodome *d* (201) is unusually large and brilliant. The base is large and smooth. The pyramid *o* (21) is small, *u* (111) and *i* (223) large and brilliant."

From Bell Mount, "Topaz occurs at Bell Mount in a very decomposed quartz-porphyry, also as pebbles weathered out in the drift; it has not previously been recorded from this locality. Two crystals, both colourless and transparent, were examined; one is much worn and broken, and unsuitable for goniometric determination. The other has good prism and dome faces, but the pyramids are dull, and were measured in the position of maximum illustration. The base is absent. The crystal measures 13 mm. × 10 mm. × 11 mm. The coordinate angles are calculated in all cases."

Variety—*Pycnite.*

This mineral is distinguished from normal topaz by its columnar habit and very compact structure. The fracture is conchoidal to uneven; it is translucent at the edges, with a vitreous lustre on the cleavages. It is pyro-electric, infusible before the blowpipe, but blisters more readily than topaz proper. In hardness it is 7·5, that of true topaz being 8. It has the faces *a m*, and a perfect cleavage parallel to the face *c*, with planes of union sometimes parallel and sometimes making an angle with *c*. It is found in parallel columnar aggregates at the tin mines of Altenberg in Saxony, and of Schlackenwald, Bohemia. The occurrence of the local variety of topaz was apparently easily recognised as occurring at Mt. Bischoff, but was not recorded. The topaz-quartz-porphyry of this locality is in all probability the most extensive, and mineralogically the finest development, of the variety pycnite of topaz proper that has hitherto been investigated.

A detailed paper upon the subject, entitled "On the Topaz-Quartz-Porphyry or Stanniferous Elvan Dykes of Mt. Bischoff," by Mr. W. H. Twelvetrees and the writer, has appeared in the Pro. Roy. Soc. Tas., 1897, from which the following is taken:—

"That dykes of an acidic porphyritic rock traverse the Palæozoic slates and sandstones at Mt. Bischoff is well known. This rock carries topaz both crystalline and amorphous, and that mineral at Mt. Bischoff appears always to be associated with cassiterite. Professor Krause, alluding to these dykes, says: 'The white porphyry composing the summit of Mt. Bischoff contains in a felsitic base crystals of quartz and an abundance of fine-grained amorphous topaz, with here and there a cavity lined with groups of radiating acicular crystals of topaz. Pseudomorphs of topaz after quartz are also not uncommon.' This, perhaps, is the latest description of the rock in question, but it applies to only one variety of a very variable rock. In prosecuting our investigations our aim has been to obtain samples as little altered as possible, in the hope of being able to detect the presence of minerals of the parent rock. We have succeeded in finding specimens showing constituents which have not succumbed to the obliterating process of topazisation. When sliced they reveal quartz felspar and mica as porphyritic constituents. The felspar outlines are mostly filled in with talc and radiating crystals of topaz (pycnite). This explains the rarity of felspar in the altered rock. Topaz crystals settle in the interior of a crystal of felspar, replace its substance, and finally its outline is lost in the groundmass of the rock. In this way many phenocrysts are now indeterminable. This topazisation is what Rosenbusch calls a pneumatolytic phenomenon, viz., the development of topaz and tourmaline in rocks proceeding from granite. Fluoric and boracic vapours, given off at the time of intrusion and consolidation of the vein-matter, are recognised as agents competent to effect the observed results. These solfataric vapours under hydroplutonic conditions act upon a magma protruded from a deep-seated rock-mass containing the elements of a granite. The protruded rock-vein thus becomes topazised and tourmalinised. It is hardly possible to separate physically the moments of topazisation and final consolidation, for we must conceive of this process being at work while the veinmass was, as a whole, still viscous. The phenocrysts of felspar were probably attacked and digested during their passage from below. The Mt. Bischoff rock is essentially a vein-rock, and we are disposed to refer it to the elvan group as a topazised elvan-rock (now topaz-quartz-porphyry). . . . . . . In the Mt. Bischoff rock the felspar of the groundmass has been replaced by topaz. The analysis recorded by Von Groddeck showed no alkali, and the rock consisted practically of quartz and topaz; but this would naturally be the case in parts of the rock when the topazisation process had proceeded to its ultimate stage. In certain of our slides the substance as well as the form of the felspar has survived, and we are thus able to diagnose the original rock as containing porphyritic crystals of quartz, felspar, and mica floating in a groundmass which is sometimes composed of granular allotriomorphic quartz, sometimes of crypto-crystalline or felsitic matter, but usually besprinkled with scales of aluminous talc, derived from felspar and mica. When the dykes contain less topaz, as on the North-Valley side, we have detected a felsitic groundmass. We may here mention that the survival of felspar is a rare occurrence. What petrological observers have seen hitherto have been crystal forms only; and what is pointed out to the visitors at the mount as kaolin is really a white decomposed product of pseudomorphous topaz and tourmaline. The quartz phenocrysts are idiomorphic, sometimes with perfect outlines, or with rounded corners and indentations. Fluid inclusions are present, with fixed and moving bubbles. . . . . A very interesting feature is the conversion of quartz to topaz, which is visible in hand specimens. A quartz-sintery-looking rock, composed of quartz in hexagonal prisms, shows its individual crystals bordered with a white cloudy marginal zone of pseudomorphous topaz. Heated in the open tube its vapour etched glass. This topaz effervesces slightly when treated with H Cl, owing to the unexpected presence of lime, derived possibly from the alteration of sphene and apatite. We witness here a second conversion—that of topaz into prosopite, a double fluoride of calcium and aluminium. When this change is effected topaz loses its transparency, becomes cloudy and opaque, its hardness diminishes, and its specific gravity becomes less. Von Groddeck describes this pseudomorphism fully in his paper, 'On the Tin-ore Deposits of Mt. Bischoff, Tasmania,' 1886. Sandberger quotes this rather peculiar mineral from Altenberg, Geyer, and Hengsteverb, in Saxony, and mentions that he has often remarked pseudomorphoses of prosopite aggregates after pycnite and crystalline topaz. Vauqulin had previously noticed the presence of calcium and water in pycnite from Altenberg, which is explicable upon the conversion theory."

At the Shepherd and Murphy Mine, Middlesex, a most interesting and remarkable form of what may be presumed to be altered topaz occurs. In portions of the mine it is apparently fairly abundant, forming in part the cassiterite-wolframite-bearing gangue of the lode. A still more advanced alteration occurs in quantity. This extreme change has reached the final homogeneity, and will be referred to later. The substance is commonly massive and granular, but crystals are not rarely met with. They usually exhibit interlocked growths, and are thus rough and irregular in development. The common habit of the crystals is prismatic, short, and irregularly striated, much distorted and compressed; the system is apparently orthorhombic. The mineral has a slightly lamellar structure, the cleavage is fairly perfect, and the surfaces of cleavage faces are inclined to be pearly. Fracture crystalline, uneven, though with a glimmering lustre. Colour greenish-gray to almost olive-green, and distinctly translucent at the edges.

Crystals and irregular patches of cassiterite, and more rarely wolframite, are enclosed or attached with disseminated fluorite of various tints, but this mineral is usually pale-purple with an almost colourless nucleus, and may be pseudomorphous after beryl, judging from the crystallographic outlines. The least unaltered portion is not uncommonly enclosed and surrounded by a substance which is the more advanced alteration product. The hardness varies from 3·5 to 4; specific gravity = 3·4 3·5. Optically, refraction and double refraction strong. In thin micro sections it appears to be perfectly homogeneous. When tested in closed tube it gives off water with an acid reaction upon the insertion of a strip of litmus paper. When strongly heated it shows sporadic phosphorescence in small patches, which may be caused by disseminated particles of fluorite. On strongly heating it becomes dull and somewhat paler in colour. In forceps it is infusible. In powder on platinum wire it glows and gives the flame of Ca. On coal in powder it does not fuse or intumesce. With $Na_2 CO_3$ there is no perceptible reaction. With borax bead a very slight trace of Fe is observable. With nitrate of cobalt, gives fairly distinct reaction for aluminium. In matrass the powdered mineral gives a distinct reaction for H_2O, showing the substance is hydrated, leading to the supposition that it may be related to the hydrated fluorine compounds fluellite and prosopite. ($Ca\ F_2\ 2\ Al\ (F_1\ OH)\ 3.$) It may be remarked that a pale green-coloured variety occurs in Utah. (See Hillebrand, Am. G. Sc., 7, 53, 1899.)

Under the influence of the emanation of radium bromide this altered topaz exhibits some peculiarities which are worthy of note. With radium bromide (of 1,800,000 intensity), using a thin sheet of metallic aluminium as a filter to the natural glow of the preparation which is interposed between the assay and the cell containing the radium, a pale but very distinct greenish light is observed This is apparently characteristic, as all the specimens thus examined gave the same result; but after the mineral was strongly heated in the platinum forceps it did not in any manner respond to the radium emanations. The substance under examination continued to show the phosphorescent light for a considerable period after removal from the vicinity, and consequent influence of the radium. Although in all the numerous tests made, this reaction was thoroughly constant and satisfactory, the glow emitted was not nearly so strong or decidedly green in colour as that from the variety of fluorite known as chlorophane.

This altered form of topaz differs from zoisite in not fusing to a light-coloured slag, in giving off more H_2O in matrass, in being less hard, and in not gelatinising with HCl after fusion. Epidote has nearly the same composition as zoisite, but contains as an essential much Fe, and thus affords a black slag by fusion on coal. Wollastonite is easily decomposed by HCl with the separation of Si, but does not form a jelly. It is also easily fusible to a glassy globule; it therefore cannot belong to this species. In addition there exists a dissimilarity in both hardness and specific gravity. It has a strong outward resemblance to spodumene, and has been considered one of the alteration products of that species.

As the substance presented so many unusual characters, a specimen was submitted to Mr. Robert Sticht, who generously had most careful analyses made, and as his report is replete with scientific data of considerable mineralogical interest it is herewith produced in full. Mr. Sticht remarks:—

"The results on No. 1 are as follows:—The contaminations were knocked off, and only the clean material was analysed. However, it was quite obvious that even this contained an admixture of fluorite, which could not very well be separated, so that it has undoubtedly affected the analytical results. The latter are as follow:—

		Per cent.
Insoluble portion	=	85·4
Soluble portion—		
Al_2O_3	=	4·0
CaF_2	=	6·96
Loss on ignition	=	4·8
		101·16

This has to be explained as follows:—The insoluble portion was that part not affected by acids. The soluble portion was extracted by treatment with aqua regia, but as the 'solubles' and 'insolubles' did not add up 100 per cent. a special test was made by subjecting the stuff to a fairly high heat. In this treatment, not alone whatever water may have been present there was driven out, but doubtless also a certain portion of fluorine, and, as it may have been present, some hydroxyl, which is now considered to be present in topaz. For this reason the determination of the 'solubles' is probably slightly incorrect. Nevertheless, the errors do not affect the general acceptation of the material as topaz. It is only a moot point whether the soluble alumina is to be added to the insoluble alumina or not. As far as concerns the calcium fluorite, which was found in the soluble portion, this may be regarded as being extraneous matter, but it is uncertain how much fluorine may be included in the ignition loss. The insoluble portion analysed for itself gives the following results:—

		Per cent.
SiO_2	=	29·6
Al_2O_3	=	47·0
F	=	12·6
		89·2

The analysis as a whole may therefore be arranged as follows, allowing a small discrepancy in the fluorine:—

		Per cent.
Found total—		
SiO_2	=	29·6
Al_2O_3	=	51·0
Ca	=	3·57
F	=	15·9
		100·07
Ignition loss, *i.e.*, H_2O, HO, F, &c.	=	4·8
		104·87

"Rearranging according to solubility, we have as follows:—

Insolubles found— Per cent.
SiO_2 = 29·6
Al_2O_3 = 47·0
F = 12·6
89·2

Solubles found—
Al_2O_3 = 4·0
CaF_2 = 6·99
10·99

100·19

"I have allowed a small disparity to creep in here in the fluorine. The amount actually found in the "insolubles' was 12·6 per cent.; the total was 15·9, leaving for the soluble part F 3·3 per cent. The 3·57 per cent. Ca, however, require 3·42 F, giving a total of 6·99. To simplify matters, and in view of the difficulty of determining fluorine, I have taken this 6·99 rather than leave any of the CaO free, which would be an unnecessary complication.

"Taking the 'insoluble' portion alone, we find that its percentage composition is—

Per cent.
SiO_2 = 33·19
Al_2O_3 = 52·69
F = 14·12

100·00

Now, it is quite possible that one is acting correctly in adding the 'soluble' alumina to that in the 'insoluble,' for the reason that doubtless topaz is affected by acids, just as it is affected by heat, so as to suffer a decrease in weight. If the 'soluble' and 'insoluble' alumina are taken together, and the CaF_2 is excluded, then the figures become as follow:—

Per cent.
SiO_2 = 29·6
Al_2O_3 = 51·0
F = 12·6

93·2
CaF_2 = 6·99

100·19
Loss, H_2O, HO, F = 4·8

104·99

The percentage composition of the first portion is—

Per cent.
$Si\ O_2$ = 31·76
$Al_2\ O_3$ = 54·72
F = 13·52

100·00

If this is brought to the 107 per cent., which is the usual result of a topaz analysis, we get—

Per cent.
$Si\ O_2$ = 33·98
$Al_2\ O_3$ = 58·55
F = 14·47

107·00

This shows the effect of a deficiency of fluorine, as compared with the analyses in Dana.

"Assuming that topaz is a silicate of alumina, with portion of the oxygen in the aluminium oxide replaced by fluorine, then the composition becomes the following:—

Per cent.
Insolubles—
$Si\ O_2$ = 29·6
$Al_2\ O$ = 39·78
$Al_2\ F_6$ = 18·54

87·92
Admixed $Ca\ F_2$ = 6·99

94·91
H_2O, HO, F, &c. = 4·80

99·71

The final conclusion is that, "on the whole, it may be stated that the analysis presents a remarkable likeness to Dana's No. 8 from the Mt. Bischoff massive topaz" (*vide* Dana, "System of Mineralogy," page 494).

Alteration Product—ACHLUSITE *(Fluosilicate of Aluminium and Sodium + $H_2\ O$).*

This extreme homogeneous derivative of the last-mentioned alteration product of topaz is generally of a rich oil-green colour, showing from somewhat pale to dark-green shades. Occasionally it is bright-green It has a waxy to resin-like lustre, with a smooth and unctuous feel, with much the general appearance of ordinary steatite. It is always opaque, but shows slight translucency at the edges. There are numerous irregular cleavages, the surfaces of which are usually extremely smooth and polished. All indications of crystalline structure are perfectly masked. The hardness is much lowered = 2 - 2·5. The substance does not respond to the emanations of radium bromide. This may be classed as a member of that most unsatisfactory group known as the hydro-micas, but distinguished by the high sodium contents, as shown by the analysis so kindly undertaken by Mr. Robert Sticht. It apparently occurred in quantity in following the lode at the Shepherd and Murphy Mine associated with considerable fluorite, and not rarely with embedded cassiterite, wolframite, and normal, well-developed, small crystals of topaz, which were in no respect altered.

The following are the analysis and remarks afforded by Mr. Sticht, viz.:—

"The analysis of this presented no such difficulties as No. 1, and is as follows:—

		Per cent.
Total $Si\ O$	=	40·6 (nearly all insoluble)
„ Al_2O_3	=	37·0
„ MgO	=	0·72
„ K_2O	=	2·29
„ Na_2O	=	6·32
„ CaF_2	=	5·1
Loss on ignition	=	8·4
		100·43

This analysis also shows the presence of fluorite, as well as a fairly heavy amount of volatile matter, together with which, however, may likewise be included HO, F, &c. There was about 73 per cent. of insoluble residue, which included nearly all of the silica and most of the alumina. It only contained a trace of F, so that the dissociation of the original topazisation was complete; but very little of the silica went into the portion soluble in acids, 8 per cent. of the alumina accompanying it, together with some of the other elements."

Although topaz is presumed to originate in the acid rocks, such as granite, by pneumatolytic action, and in some cases to be of secondary origin, it may itself suffer extreme alteration and decomposition by substitution and hydration, and by this means, as before stated, pass into such substances as the hydro-micas.

331. TOURMALINE *(Silicate of Aluminium, Boron, and other Elements).*

This species belongs to the hexagonal system of crystallisation, but commonly assumes the form of three-sided prisms. which are strongly striated longitudinally, and have rhombohedral faces at the crystal extremities. The opposite extremes of the crystals are dissimilarly terminated, hence they are hemimorphic; they are also pyro-electric to a marked degree. This mineral affects commonly a columnar habit, which is often strongly radiating or divergent. It varies in colour to an infinite degree. In this island it is only known to occur black, brown, and green. Many of the highly-coloured kinds are valued as gems, such as the rubellite or red variety, the indicolite or blue variety; but the green, puce, and other colours are also highly valued when clear and transparent. Tourmaline of the black or schorl variety is a most persistent companion of tin ore, and with the exception of quartz the most abundant associate. It is often minutely disseminated throughout tin-bearing rocks. Rocks are almost always tourmaliniferous in the tin-mining districts here as elsewhere. It is generally supposed to have been formed by the action of boron and fluoric vapours acting on the felspathic and micaceous constituents of the acid stanniferous rocks. Rosenbusch says ("Microscopical Physiography," p. 184) that, "Tourmaline is not directly secreted out of the eruptive magma in eruptive rocks, but resulted from the action of fumaroles, carrying fluorine and boron, on the eruptive rock, especially on its felspar and mica." The common black variety occurs abundantly in drift at Moorina, and in the vicinity of Mt. Cameron, the undivided prisms sometimes measuring over 2½ inches in diameter; at Killikrankie Bay and the south end of Flinders Island it occurs of large size, penetrating the altered granite as well as in free lumps; in the tin-wash it occurs with topaz and large quartz crystals; at Heemskirk it is remarkably plentiful, often in radiating bunches of considerable size—the crystals have been found penetrating and enclosed in quartz. At Ben Lomond it is equally abundant, and generally on the eastern tinfields; at Schouten Main; Granite Tor; Mt. Cameron; Housetop; Cape Barren Island; Pieman River; Meredith Range; at Mt. Ramsay; in the stanniferous granite abutting on to amphibolite; and at Bell Mount, Middlesex. In short, it is extremely rare to find tin ore unaccompanied by this mineral. Green tourmaline, or zeuxite, is a local form, which at Mt. Bischoff is extremely abundant, and practically constitutes a rock-mass in portions of the mine. The crystals are small, and so interwoven as to partake of the nature of a felted mass. The crystals rarely exceed an inch in length, being commonly quite minute. They sometimes form fine tufted masses of radiating acicular crystals in small cavities. It varies at the Bischoff to a greyish-blue colour, but the green is the most abundant. The finest development of this variety occurs at the Stanley River, at which locality the individual crystals are often larger than those so abundant at Bischoff, and the colour is more intense. It also occurs sparingly at one or two places on Mt. Heemskirk, and at all localities it appears to accompany tin ore. Brown tourmaline occurs in somewhat small prisms arranged as radiating bunches in a quartz matrix at Mt. Ramsay; while at Glenora, near the Gap at Mt. Heemskirk, it occurs rather abundantly of a distinct dull hair-brown colour. The common black form is also known under the Cornish vernacular name of "schorl." Pseudomorphs of the green-coloured variety after orthoclase are fairly common at the Stanley River, and also occasionally occur at Mt. Bischoff. The light greyish-blue, dense, and more massive tourmaline of Mt. Bischoff was analysed by Dr. H. Sommerlad in the laboratory of the Royal Mining Academy of Clausthal, Hartz, with the following results:—Silica, 26·86; alumina, 36·72; boron trioxide, 10·56; iron protoxide, 5·66; manganese protoxide, 0·66; lime, 0·34; magnesia, 3·92; potassa, 1·11; soda, 3·57; water, 1·16; fluorine, 0·61; total, 101·17. Spec. grav., 3·042. At Mt. Ramsay this "schorl" variety occurs as long, intensely black prisms, of the characteristic form, penetrating and embedded in solid white quartz. The individual prisms are at times up to nearly 3 inches in length and well formed.

"One of the most noteworthy occurrences of tourmaline in Tasmania is that which is developed in the granite of Mt. Heemskirk. The normal granite has a reddish hue, and contains areas in which the colour is notably paler. The latter variety is characterised by the presence of an enormous number of spheroidal nodules composed of quartz and tourmaline, the majority of which range in diameter from 2 to 5 inches. They prove more resistant than the granite enclosing them to the process of weathering, and therefore stand out in relief upon the exposed faces of the rock. The nodules usually show a radial arrangement of their constituents. Those areas in the granite in which these nodules are developed carry the stanniferous lodes." (L. K. Ward.)

This mineral, which characterises a common modification of the acid rocks, more notably near the selvage of contact, or may more rarely permeate rocks adjacent to the granite, and whose presence depends upon the actual introduction of boron and fluorine emanations, has been obtained in the vicinity of Mt. Lyell, at a locality in proximity to the original mine workings, on what is now the property of the Mt. Lyell Mining Company; but the exact spot cannot now be detected. It was reported to afford a remarkably high assay return for gold, but that, judging from the specimens now in collections, is open to doubt. It occurs as a closely interwoven, fibrous, and matted mass of a dark-green colour, throughout which are interspersed patches and irregular granulary milk-white quartz. The tourmaline, both green and brown, is often in the form of extremely fine, almost micro, hemihedral needles which not rarely show a distinctly divergent and radiating grouping, the needles often embedded and penetrating the quartz granules. The general colouration and character of the occurrence separate it from any other known form of the species occurring in the island, although it has some resemblance to that so abundant at the Stanley River, and still more distinctly to the well-known occurrence at Mt. Bischoff.

As tourmaline has not previously been recorded from Mt. Lyell or vicinity, the occurrence is of some special interest. It may be noted that the distinctly acid mineral molybdenite has been detected, but in extremely small quantity, on the Lyell Tharsis Mine, which is in the neighbourhood of the reputed locality from which the specimens of tourmaline now in question were obtained, and about which occurrence no doubt can exist.

332. TUNGSTITE *(Tungsten Trioxide)*.

Occurs as pulverulent, earthy, and, more rarely, semi-crystallised patches and bands of a more or less intense yellow colour. It is commonly adherent to and coating wolframite, from the decomposition of which it is derived. Ben Lomond. It has occurred with wolframite and scheelite in a quartz matrix at the North Pieman Heads.

333. TURGITE *(Hydrous Sesquioxide).*

An iron ore with the general aspect of fibrous hornstone, with a red streak. Hardness = 5, 6. Localities: Blythe River; at the Comet Mine, Dundas; the Manganese Hill, Zeehan; at the Magnet it is fairly plentiful as a portion of the lode outcrop.

This is a common ore of iron, which is often mistaken for limonite. It may be distinguished by its pronounced decrepitation. It contains 5·3 per cent. of H_2O.

334. URALITE *(Pseudomorphous Amphibolite, with the external form of Augite).*

This secondary mineral has been optically detected in petrographical work, and in the limurite rock of the Colebrook its presence is very pronounced. It is derived from the alteration of augite, which in the limurite is often further advanced to actinolite.

335. VANADINITE *(Vanadate of Lead).*

Obtained in extremely limited quantity as small implanted globules and thin incrustations on siderite, with minute crystals of galenite and sphalerite. It is of a reddish-yellow colour normally, but weathers yellow, and again fades to a dirty-brown. Bell's Reward Mine, Heazlewood, and at the Hampshire Silver Mine. Occurs in groups of hexagonal prisms of a deep reddish-brown, with a resinous lustre, Magnet Mine.

336. VARISCITE *(Hydrous Phosphate of Aluminium).*

As incrustations, often with a uniform surface. General character somewhat dull, but of a bright emerald-green colour, and thus sometimes mistaken for an ore of copper. Associated with wavellite, Back Creek; and implanted on the cleavages of quartz, Lefroy.

337. VAUQUELINITE *(Chromate of Lead and Copper).*

This is a rare mineral, which hitherto has been considered peculiar to the silver-lead mining districts of Siberia. The mineral as occurring here has a peculiar siskin-green colour. It is found in an amorphous, somewhat mammillated, mass, of a dull appearance. Before the blowpipe and in nitric acid it gives all the characteristic results. It has been obtained in moderate quantity with galena and arsenical pyrites, near George's Bay; in minute particles with crocoisite, Adelaide Proprietary Silver Mine, Dundas.

338. VIVIANITE *(Phosphate of Iron).*

In groups of crystals, which are occasionally nearly half an inch in length; from cleavage planes in rock. adit, Mt. Bischoff; in blue and green amorphous clay-like mass, Waratah River; in crystallised bunches, No. 1 North Pioneer Reef, at Waterhouse; as a soft clay impregnated with the phosphate, Supply Creek; of a dark-blue colour in fibrous radiating bunches, with granular quartz, Lucy Creek, Pieman River; in large quantity disseminated in decomposing argillaceous shale, North Bischoff.

339. VOLTZITE *(Oxysulphide of Zinc).*

Formed as an incrustation of a thin lamellar structure, and globular; colour, clove-brown; very rare. Silver Crown Mine, Zeehan. Also in small quantity at the Hercules Mine, Mt. Read.

340. WAVELLITE *(Hydrated Phosphate of Aluminium).*

This is always in all known localities a rare mineral. It has been discovered in a rock-cutting in a greyish-green clay slate. The mineral occurred in the cleavage planes of the rock in the form of flaky radiating discs and hemispherical forms of a white and glistening appearance, which are usually under an inch in diameter.

Australasian Slate Quarry, Back Creek; on the Forth River, south of the Van Diemen's Land Company's block in 1864, associated with galena and blende (James Smith); at Mt. Ramsay, as white circular patches with a strongly radiating structure and glistening surface, implanted upon hornblende; of small size in altered slate at Mt. Bischoff; also at the Den, near Lefroy.

This mineral was first noticed by Professor G. H. F. Ulrich, about 1876, on the occasion of an inspection of, and report upon, the Australasian Slate Quarry, Back Creek, for Messrs. Lyell and Gowan, Melbourne. Many fine examples were then collected, a series of which Professor Ulrich placed in the mineral collection of the Technological Museum, Melbourne. Occurs in small white discs, with the characteristic radiating structure implanted on the cleavages of sandstone; Ballast Quarry, Zeehan-Comstock Line; also as small globular aggregates of a pale yellowish-green, in cavities in limestone, Mole Creek.

341. WELDITE *(Silicate of Aluminium and Soda).*

"Amorphous; under the microscope, cryptocrystalline; optically negative; H = 5·5; G = 2·98. Lustre, vitreous or pearly, opaque, white; in thin splinters, subtranslucent; tough; fracture even. Comp-silicate of alumina and soda, with traces of lime and ammonia. Before blowpipe fuses at 3 with intumescence to a blebby glass. From the unequal distribution of free silica and the presence of ammonia, it is probable that the substance is the product of transmutation of a felsitic or kaolinitic rock. If it can be shown from its mode of occurrence that it is not merely an altered rock, then it is undoubtedly a new mineral species, to which the appropriate name of weldite might be given. (Note by Professor F. M. Krause, of the Ballarat School of Mines, in the Proceedings of the Royal Society of Tasmania, 1884.)

Locality: Weld River, Upper Huon (C. Glover). Mr. F. Stephens states "It may be described as a massive band interstratified with bands of quartzite and other altered rocks; and Mr. Glover has traced it for a mile in the direction of its strike" *(loc. cit.).*

342. WILLEMITE *(Anhydrous Silicate of Zinc).*

Obtained in small compact patches, yellow-brown colour and dull lustre. Bell's Reward, Whyte River, and at the Heazlewood Silver-lead Mine, Heazlewood River.

This mineral belongs to the hexagonal system, but is only known to occur in this island in the amorphous form.

343. WULFENITE *(Molybdate of Lead).*

A somewhat rare salt of lead. It crystallises in the tetragonal system, but affects thin tables, which are often extremely so and quite clear. It varies much in colour, being often bright orange-yellow, or again brown, and occasionally green.

"Occurs, though rarely, in the lode of the Hampshire Hills Silver Mine, associated with very fine-grained galena and sphalerite. The crystals are of a brownish-yellow colour, and square, thin, tabular, with rounded basal plane, and hemihedral planes of the octagonal prism are distinctly recognisable round the edges." (Ulrich.)

344. WOLFRAMITE *(Tungstate of Iron and Manganese).*

This mineral crystallises in the monoclinic system, although its common mode of occurrence is in the massive state. It is usually in opaque, brownish-black, cleavable masses; more rarely in distinct, more or less radiating blades, with a brilliant lustre and brown streak. It is a common associate of tin ore, the separation from which causes considerable inconvenience to the miner. The usual method successfully adopted for the separation of the tin ore from the contaminating wolfram is to use one of the several magnetic processes. The specific gravity of the two minerals so closely approximates that separation by gravitation is rendered practically impossible. Wolframite has become of great economic importance, as a small proportion of tungstic acid has been found to increase the hardness and tenacity of steel; hence, when used in this way, the resulting acetate is known commercially as tungsten steel. It is one of a group of minerals constantly connected with the acid eruptive rocks, consequently the associated gangue is almost invariably quartz. The pure mineral contains approximately 60 per cent. of the metal tungsten, or, as the element is sometimes called, wolframium. A nearly pure $Mn\ WO_4$, named hübnerite, is fairly well known as occurring under similar conditions and associations as wolframite, but it has not been detected in this State. It is known to occur in New England, New South Wales. It is brownish-red to brown in colour, with small bladed habit, and may be easily overlooked. From a commercial point of view this form is equally as valuable as wolframite, but has not been found so abundant in nature. The rare tetragonal species reinite is only known as from Kei, Japan.

Ferberite, a presumed $Fe\ WO_4$, with a small amount of manganese, has been described from Spain. The physical characters of this variety exactly agree with the mineral occurring at the Oonah Mine, Zeehan. It is massive, granular, with some imperfect planes of crystallisation, with an imperfect vitreous lustre, and submetallic. It is sparingly found closely mixed with stannite and pyrites in what is known as the stannite lode. At the All Nations Mine, Middlesex, some remarkably fine crystals have been obtained. They were large, extremely black, and lustrous, rivalling those from the classic localities of the Zinnwald and Schlaggenwald. They occurred implanted on the side of a cavity in a quartz lode, the crystals of quartz being almost equally well developed. At the Shepherd and Murphy Mine, at the same locality, similar crystals are not infrequent, but they are somewhat smaller in size, occasionally showing interesting terminations and modifications. In this mine they accompany, besides the usual quartz, small topaz crystals, with cassiterite, bismuth (sulphide and carbonate), fluor and talcose spodumene. At the mineral section originally known as the Mt. Black Prospecting Association, at Mt. Dundas, it occurs in small patches in a dense mass of fluorspar and chalcopyrite, with, more rarely, blades of bismuthinite, and intensely black radiating bunches of tourmaline.

About 1 mile a little east of south of the Mayne's Tin Mine, at Heemskirk, on the extreme west, a very interesting find of partially pseudomorphous wolframite has been made. The crystals of the original mineral are extremely well-formed, of the normal character, and fairly large in size. The whole mass of the crystals is more or less altered to scheelite. Sometimes the planes are faced by a thin layer of the tungstate of lime of a glistening pale-yellow colour, and more rarely one-half of the crystal will appear to be thus transmuted. At the Bischoff Mine, wolframite is remarkably rare, and when found it is in but comparatively small patches attached to the topaz-porphyry so characteristic of the mine. It is stated by the late Professor Ulrich to occur pretty frequently in the West Bischoff tin lode in aggregations of rather ill-developed crystals, also impregnated in small patches and irregular grains. The matrix is generally quartz, but sometimes an intimate mixture of apatite and topaz occurs, and in hollows of such specimens the rare mineral monazite is found.

At Storey's Creek and other places in the vicinity on Ben Lomond a considerable quantity has been mined and exported. It occurs with cassiterite, with quartz, in somewhat altered granite impregnated with white muscovite mica. Other localities are the Ethel Mine, Blue Tier; North Pieman River, near the coast; Black Bluff Mountain; Mt. Thomas, near Mt. Claude; Great Mussel Roe River; Mt. Rex Tin Mine; and other places of less importance.

345 WOLLASTONITE *(Silicate of Calcium).*

Also known as "tabular spar." It is doubtfully referred to the pyroxene group. It belongs to the monoclinic system of crystallisation, and is common to metamorphic limestone formations, and in regions of granite, as a constant alteration. It occurs at Highwood, south of the Hampshire Hills, where it apparently gradually merges into a crystalline rock much resembling a variety of diallage. Here it is white and granular, with individual fibrous structure. At the Shepherd and Murphy Mine, Bell Mount, it is found in patches and veins in the garnet rock.

346. WURTZITE *(Hexagonal Zinc Sulphide).*

A rare zinc mineral, differing in crystallisation from sphalerite. It is hemimorphic in habit, and by that character may be recognised when in crystals. Usually it occurs in columnar masses. Hercules Mine, Mt. Read; and Magnet Silver Mine, Magnet.

347. YANTHOSIDERITE *(Hydrous Sesquioxide of Iron).*

This oxide of iron is found as an incrustation, often in silky needles of a bright-red colour, but usually occurring in a powdery form. It is abundant coating the vughs in and on the harder portions of the gossan capping the lode at the Magnet Mine. It is often found exuding from the roof and walls of old mine workings, as is the case at the Farrell Mine, at Tullah.

348. YTTROCERITE *(Hydrofluoride of Calcium, Yttrium, and Cerium).*

This is a rare mineral, occurring in amorphous masses of small size, which usually exhibit a subcrystalline surface. It is reddish-brown in colour, and occurs imbedded in the amphibolite rock peculiar to Mt. Ramsay. (W. R. Bell.)

In writing about this mineral the late Professor Ulrich remarked, "I have a suspicion that this mineral has probably been mistaken by Mr. Bell for either axinite or titanite, both of which I identified in the Mt. Ramsay amphibolite."

349. ZARATITE *(Carbonate of Nickel).*

This mineral is also termed "emerald nickel," from its beautiful green colour. It occurs as varnish-like coatings, and as thin incrustations on chromite and magnetite, being constant to one or the other. It more rarely forms mammillary or stalactitic crusts on the same minerals. Although containing 59·6 per cent. of nickel protoxide, it is too uncommon in nature to be of any commercial importance as an ore of the metal. It is probably more profuse at its only known locality in this island, in a high hill on the north side of the Heazlewood River, than at any other recorded locality. It is found at the Heazlewood in connection with the serpentine of the locality, coating the walls of irregular fractures and incrusting the minerals connected with that rock, and always more or less in association with a highly nickeliferous variety of pentlandite. It has been reported to occur in limited quantity at Texas, Pennsylvania, U.S.A.; in Galicia, in Spain; at Unst, Shetland Isles; and a few other localities.

350. ZEOLITES.

These are a well-marked series of crystalline hydrated silicates, all containing aluminium, but in the great majority a proportion of calcium or sodium, or in many cases both, are present. They result from the alteration of felspathoid minerals and felspars. Many are somewhat unstable, and sometimes merge into each other. The hydration may occur as water of crystallisation, but also as hydroxyl belonging to the silicate molecule. They are remarkably plentiful, both as to quantity and species, in basic amygdaloidal rocks, although they are not unknown in mineral veins. The nephelinite of the Shannon Tier produced several fine species, all of an immaculate milk-white. The basaltic rocks of Middlesex, Patersonia, Derby, Bischoff, and elsewhere in the island are replete with more or less fine examples of these model crystallisations. The Mesozoic diabase, which is so pronounced a feature in the geology of the island is not without interest from a zeolitic aspect. The phonolitic complex of Port Cygnet affords a few forms, and the same is the case with respect to the trachydolerite of Table Cape and Circular Head.

See ANALCITE, CHABASITE, GMELINITE, HYDRONEPHELITE, LAUMONITE, MESOLITE, NATROLITE, PHACOLITE, PHILLIPSITE, SCOLECITE, STILBITE, THOMSONITE.

351. ZEUXITE (*Ferriferous Tourmaline*).

A peculiar variety of tourmaline of a dark-green colour and tufted habit. It is remarkably characteristic of the tin occurrence at Mt. Bischoff, where it is found in vast abundance, often forming rockmasses of considerable size. Its common habit is as short acicular crystals, which are irregularly interlaced together. It is found at the Stanley River tinfield in considerable quantity, and it has also occurred at one or two localities at North Heemskirk in connection with the tin lodes there. At the Stanley River it is also found pseudomorphous after orthoclase felspar.

352. Zincite *(Oxide of Zinc).*

Only known to occur as small amorphous patches on siderite, quartz, and other veinstone. The colour is a somewhat bright red. Heazlewood Silver-lead Mine.

353. Zircon *(Silicate of Zirconium).*

This mineral is isomorphous with cassiterite. It forms when cut and polished a beautiful gemstone, for which purpose the Tasmanian specimens are peculiarly adapted on account of their high lustre, in which respect they perhaps excel those from all other localities, although they are not, as a rule, so highly coloured as those obtained in Northern New South Wales and Southern Queensland.

As occurring here they are usually more or less transparent. In colour they vary through many shades of brown to red, and although occasionally fine clear stones of good colour are obtained, they are usually much clouded with darker tints. The zircon presents three distinct varieties of colour, viz., the jargon, yellow-brown; the hyacinth, bright red; and that termed zirconite, which is almost opaque, and reddish-brown in colour. All three are fairly abundant here. In this island it has not apparently been obtained *in situ*, but doubtless originates from the detritus of the granite rock. It is abundant in the stanniferous drifts of the North-East Coast, where it occurs with topaz, pleonaste, and quartz. Well-developed crystals are of extreme rarity, as they are generally much waterworn. The specimens from near Table Cape are, as a rule, darker and brighter in colour than those occurring on the tinfields; but they are commonly more fractured, although fairly good crystals are not nearly so rare.

It has been found clear and colourless at the Blythe River; in beautiful glassy and lustrous crystals, ranging from one-eighth of an inch in length to extremely minute, Meredith Range and North Fieman; in many colours—yellow, green, and red, to colourless—Boat Harbour, near Table Cape; in many variations of colour, including bright clear red, Flinders and Long Islands, Bass Strait; in large numbers, often of considerable size, in drift, Moorina, Weld River, Thomas' Plains, and other places on the North-eastern tinfield.

Abundant as a constituent in hornblende-gneiss, from the Forth River. It occurs as grains and elongated prisms which often penetrate the hornblende.

Respecting the zircons from Boat Harbour, Dr. Anderson writes ("Records of the Australian Museum," Vol. VI., Part 2, 1905):—"Mr. Petterd is of opinion that the mineral is a product of contact metamorphism in granite country. The zircon is accompanied by blue sapphires, menaccanite, and other detrital minerals. One fairly well-developed, doubly-terminated crystal was determined. The forms present are *a* (100), *m* (110), *p* (111), *v* (221), *u* (331), and *x* (131), of which *a* and *p* predominate. The crystal is dark-red in colour, and shows a striated area in one part. All the forms are present with the full complement of faces, except *u*, which has but two. The crystal measures approximately 10 mm. in diameter. Sp. g., 4·57."

354. ZINKENITE *(Sulphantimoniate of Lead).*

Although this mineral is known to crystallise in the orthorhombic system the crystals are rarely distinct, and are extremely rare. It occurs plentifully in the massive form at the south workings No. 1 level, Magnet Mine. It is constantly semi-fibrous, with an uneven fracture, metallic lustre, and steel-grey colour. As occurring at the locality mentioned it is highly argentiferous, often containing hundreds of ounces of silver to the ton. It is associated with galena, pyrites, and dolomite. In its fractures and joints there occurs a peculiar secondary mineral, which is exclusively derived from its decomposition. This secondary mineral assumes the form of very small discs composed of divergent milk-white spicules, which are commonly clustered together in radial form. They have a bright shining lustre, and hardness of about 1·5. They are closely attached to their base, and of such extreme tenuity that it is practically impossible to secure enough material for a satisfactory analysis. A minute quantity before the blowpipe gave the qualitative reactions for sulphur, antimony, and lead, with H_2O. It appears to be a basic sulphate of the metals mentioned, and is in all probability a new compound closely allied to lamprophanite.

355. ZINNWALDITE *(Lithia Muscovite).*

This is the characteristic white mica of the stanniferous granites, and as such it occurs in the old tin-mining localities, such as Zinnwald, Altenberg, and similarly in Cornwall. It is consequently abundant throughout the tin-bearing granites of the east coast mining district, and the same applies to the Ben Lomond, Heemskirk, and other localities. Before the blowpipe it fuses with intumescence, colouring the flame purplish-red; and also reacts for iron.

356 Zoisite *(Basic Silicate of Calcium and Aluminium).*

This orthorhombic mineral is of unusual occurrence microscopically, but it is an essential constituent of the zoiste-amphibolite which occurs as a schistose rock-belt near the township of Hamilton, River Forth, and the Collingwood valley.

A CLASSIFIED LIST OF THE MINERAL SPECIES KNOWN TO OCCUR IN TASMANIA.

SYNOPSIS.

I. NATIVE ELEMENTS.

II. SULPHIDES, TELLURIDES, SELENIDES, ARSENIDES, ANTIMONIDES, BISMUTHIDES.

III. COMPOUNDS OF CHLORINE, BROMINE, IODINE.

IV. FLUORINE COMPOUNDS.

V. OXYGEN COMPOUNDS.

- *I. Oxides, or Binary Oxygen Compounds.*
  - (i) Oxides of Elements of Gold, Iron, and Tin Groups.
  - (ii) Oxides of Elements of Arsenic and Sulphur Groups.
  - (iii) Oxides of Elements of Carbon-Silicon Group.
- *II. Ternary Oxygen Compounds.*
  - 1. Silicates.
    - A. Anhydrous Silicates.
      - (i) Bisilicates.
      - (ii) Unisilicates.
      - (iii) Subsilicates.
    - B. Hydrous Silicates.
      - (i) General Hydrous Silicates.
      - (ii) Zeolites.
      - (iii) Margarophyllite Section.
  - 2. Tantalates, Columbates.
  - 3. Phosphates, Arsenates, Antimonates, Nitrates.
    - A. Phosphates, Arsenates, Antimonates.
      - (i) Anhydrous.
      - (ii) Hydrous.
    - B. Nitrates.
  - 4. Borates.
  - 5. Tungstates, Molybdates, Vanadates.
  - 6. Sulphates, Chromates, Tellurates.
    - (i) Anhydrous.
    - (ii) Hydrous.
  - 7. Carbonates.
    - (i) Anhydrous.
    - (ii) Hydrous.
  - 8. Oxalates.

VI. HYDROCARBON COMPOUNDS.

I. NATIVE ELEMENTS.

Antimony
Arsenic
Bismuth
Copper
Diamond
Graphite
Gold
Iron
Lead
Mercury (?)
Osmiridium
Platinum (?)
Silver
Sulphur

II. SULPHIDES, ARSENIDES.

(Tellurides and Selenides are not known to occur.)

Sulphides.

Argentite
Bournonite
Bismuthinite
Berthierite
Boulangerite
Bornite
Breithauptite
Chalcopyrite
Covellite
Chalcocite
Dufrenosite
Freibergite
Galenite
Huascolite
Histrixite
Lillianite
Jamesonite
Marcasite
Molybdenite
Mariatite
Millerite
Plagionite
Przibramite
Pentlandite
Pyrargyrite
Pyrrhotite
Siegenite
Sphalerite
Stannite
Stephanite
Stibnite
Sternbergite
Stromeyerite
Voltzite
Wurtzite
Zinkenite

Sulpharsenides.

Arsenopyrite
Cobaltite
Proustite
Glaucodote

Arsenides.

Chloanthite
Leucopyrite
Niccolite
Smaltite

III. COMPOUNDS OF CHLORINE, BROMINE, AND IODINE.

Atacamite
Cerargyrite
Embolite
Halite
Iodyrite
Matlockite

IV. FLUORINE COMPOUNDS.

Chlorophane
Fluorite
Prosopite
Pycnite
Yttrocerite

V. OXYGEN COMPOUNDS.

I. Oxides, or Binary Oxygen Compounds.

(i) Oxides of the Elements of Gold, Iron, and Tin Groups.

Asbolite
Anatase
Beauxite
Braunite
Brookite
Brucite
Cassiterite
Chalcophanite
Chalcotrichite
Chrysoberyl
Chromite
Corundum, vars. Sapphire, Oriental Topaz
Cuprite
Diaspore
Franklinite
Göethite
Hematite
Hercynite
Limonite
Magnetite
Manganite
Massicot
Melaconite
Menaccanite
Minium
Periclasite
Picotite
Pleonaste (Spinel)
Psilomelane
Pyrolusite
Rutile
Stichtite
Stilpnosiderite
Turgite
Wad
Xanthoriderite
Zincite

(ii) Oxides of the Elements of Arsenic and Sulphur Group.

Arsenolite
Bismite
Cervantite
Kermesite
Molybdite
Senarmontite
Stibiconite
Valentinite
Wolframite

(iii) Oxides of the Elements of Carbon-Silicon Group.

Quartz—

- A. Vitreous Vars.
  - Rock Crystal.
  - Smoky.
- B. Crypto-crystalline Vars.
  - Basanite, Chalcedony, Cornelian, Prase, Sinter, Chert, Jasper, and others.
- C. Other Vars.
  - Common Opal, Resin, Wood and Semi-opal, Hydrophane, Cacholong, Menilite, Hyalite, Geyserite, and Infusorial Earth.

II. Ternary Oxygen Compounds.

1. Silicates.

A. Anhydrous Silicates.

(i) Bisilicates.

Arfvedsonite
Actinolite
Augite
Asbestos
Aegerite
Beryl
Cossyrite
Diopside
Enstatite
Hedenbergite
Hornblende
Hypersthene
Leucophanite
Pectolite
Pyroxene
Schillerspar
Tremolite
Uralite
Wollastonite

(ii) Unisilicates.

- Adularia
- Agalmatolite
- Anorthite
- Anorthoclase
- Allanite
- Axinite
- Biotite
- Chrysolite (Olivine)
- Damourite
- Elæolite
- Epidote
- Eulytine
- Fayalite
- Garnet, vars. Almandite, Aplome, Grosularite, Johnstonotite, Melanite
- Gilbertite
- Haüynite
- Idocrase
- Ilvarite
- Iolite
- Ivaarite
- Lepidomelane
- Labradorite
- Lepidolite
- Lithomarge
- Microcline
- Muscovite
- Melilite
- Marialite
- Mizzonite
- Nephelite
- Oligoclase
- Orthoclase
- Scapolite
- Smithsonite
- Zinnwaldite
- Zircon

(iii) Subsilicates.

- Andalusite
- Carpholite
- Collyrite
- Danburite
- Datolite
- Hisingerite
- Kyanite
- Pycnite
- Sillimanite
- Titanite (Sphene)
- Topaz
- Tourmaline
- Zeuxite
- Zoisite

B. Hydrous Silicates.

(i) General Section of Hydrous Silicates.

- Allophane
- Chrysocolla
- Restormelite

(ii) Zeolite Section.

- Analcime
- Chabazite
- Gmelinite
- Laumontite
- Mesolite
- Natrolite
- Phillipsite
- Phacolite
- Scolecite
- Stilbite
- Thomsonite

(iii) Margarophyllite Section.

- Batchelorite
- Chlorite
- Clinochlore
- Deweylite
- Fahlunite
- Halloysite
- Kaolinite
- Leuchtenbergite
- Margarite
- Miloschinite
- Montmovillonite
- Nontronite
- Ochre-chrome
- Penninite
- Pholerite
- Pilotite
- Plinthite
- Prochlorite
- Pyrophyllite
- Pimelite
- Rhodochrome
- Saponite
- Steargillite
- Serpentine, vars. Chrysotite, Marmolite, Picrolite, Picrosmine, Retinolite, Sicioliophite
- Sericite
- Smectite
- Steatite
- Talc

2. Tantalates and Columbates.

Perovskite
Pyrochlore
Rinkite

3. Phosphates, Arsenates, Antimonates, and Nitrates.

A. Phosphates, Arsenates, Antimonates.

(i) Anhydrous.

Alipite
Apatite
Bellite
Carminite
Dufrenite
Endlichite
Monazite
Pharmacosiderite
Plumbogummite
Pyromorphite
Scorodite

(ii) Hydrous.

Annabergite
Barrandite
Bindheimite
Erythrite
Evansite
Leucochalcite
Pitticite
Symplesite
Varicite
Vivianite
Wavellite

B. Nitrates.

(Not known to occur.)

4. Borates. (Not known to occur.)

5. Tungstates, Molybdates, and Vanadates.

Scheelite
Vanadinite
Wolframite
Wulfenite

6. Sulphates, Chromates, and Tellurates.

(i) Anhydrous.

Anglesite
Barite
Crocoisite
Beresowite
Glauberite
Leadhillite
Melanochroite
Vauquelinite

(ii) Hydrous.

Alunogen
Copiapite
Epsomite
Goslarite
Gypsum (Selenite)
Halotrichite
Knoxvillite
Melanterite
Morenosite
Phlogopite
Sclerospathite

7. Carbonates.

(i) Anhydrous.

Ankerite
Aragonite
Bismutospherite
Calcite
Calamine
Cerussite
Dolomite
Magnesite
Pennite
Phosgenite
Plumbocalcite
Rhodochrosite
Siderite
Smithsonite
Spherosiderite
Strontianite

(ii) Hydrous.

Azurite
Bismutite
Cyanosite
Dundasite
Hydrocerussite
Hydromagnesite
Hydromanganocalcite
Malachite
Selbite
Zaratite

8. Oxalates.

(Not known to occur.)

VI. HYDROCARBON COMPOUNDS.

Asphaltum
Coal
Copalite
Kerosene Shale
Lignite
Pelionite
Retinite
Shale
Tasmanite

INDUSTRIAL RETURNS OF MINING IN TASMANIA.

Decennial Return of the Gold-mining Industry.

Year.	Quantity. oz.	dwt.	Value. £
1898	74,233	0	291,496
1899	83,992	0	327,545
1900	81,175	0	316,220
1901	69,491	0*	295,176
1902	70,996	0*	301,573
1903	59,891	0*	254,403
1904	65,921	0*	280,015
1905	73,540	10*	312,380
1906	60,023	8*	254,963
1907	65,354	5*	277,607
	726,617	3	£3,011,408

*Fine Gold.

Decennial Return of the Coal-mining Industry.

Year.	Quantity. Tons.	Value £
1898	47,678	38,256
1899	42,609	38,349
1900	50,633	44,227
1901	45,438	38,451
1902	48,863½	41,533
1903	49,069	41,709
1904	61,109	51,942
1905	51,993	44,194
1906	52,895¾	44,962
1907	58,891	50,057
	509,179¼	£433,670

Decennial Return of the Tin-mining Industry.

Year.	Quantity.	Value.
	Tons.	£
1898	1972	142,046
1899	2239¼	278,323
1900	2029	269,833
1901	1789½	212,542
1902	1958¼	237,828
1903	$2376\frac{3}{20}$	300,098
1904	2171½	255,228
1905*	3891½	362,670
1906*	4472¾	557,266
1907*	4342¾	501,681
	$27,242\frac{13}{20}$	£3,077,916

*Tin ore produced; Customs having ceased to issue returns.

Decennial Return of the Silver-lead Mining Industry.

Year.	Quantity.	Value.
	Tons.	£
1898	15,320	188,892
1899	31,519½	250,331
1900	26,564	279,372
1901	28,774	207,228
1902	46,480	218,864
1903	42,422	192,492
1904	51,138	203,702
1905	75,270½	246,888
1906	87,117¾	462,443
1907	89,762½	572,560
	494,370¼	£2,822,772

Decennial Return showing the Quantity and Value of Blister Copper produced.

Year.	Quantity.	Value.
	Tons.	£
1898	4955½	400,668
1899	8598	735,305
1900	9449	907,288
1901	9981	879,625
1902	7745	462,151*
1903	6684	478,023*
1904	8371	582,540*
1905	8610	704,287*
1906	8708	862,444*
1907	8247	832,691*
	81,378½	£6,372,871

*Value of gold contained is deducted.

Decennial Return showing the Quantity of Copper Ore produced.

Year.	Quantity.	Value.
	Tons.	£
1898	394	8128
1899	1695	26,833
1900	4221½	63,589
1901	11,221	130,412
1902	5994	65,270
1903	102	790
1904	104¾	1640
1905	1150¾	52,939
1906	2234½	72,480
1907	788¼	36,975
	27,905¾	£539,056

Return showing Quantity and Value of Minerals and Metals raised in Tasmania from 1880 *to* 1907 *inclusive.*

Mineral or Metal.	Quantity.	Value.
		£
Gold	1,530,676 oz.	6,030,671
Silver-lead Ore	604,266 tons	4,057,364
Blister Copper	86,090 ,,	7,168,767
Copper and Copper Ore	28,014 ,,	462,326
Copper Matte	6227 ,,	133,736
Tin	89,515 ,,	8,589,181
Iron Ore	39,162 ,,	24,101
Coal	992,150 ,,	850,165
Wolfram	165 ,,	11,551
Bismuth	4¼ ,,	866
Asbestos	374 ,,	521
Unenumerated prior to 1894	...	31,988
	Total value ...	£27,361,237

The above returns are taken from the Report of the Secretary for Mines for the year ending December 31, 1907.

SYSTEMS OF CRYSTAL FORMS.

No. I. Isometric—also known as the *Cubic*, *Tesseral*, *Regular*, and *Monometric*.

All forms having three equal axes at right angles to each other are referred to this system.

Represented by: Galena, sphalerite, garnet, diamond, fluorite, tetrahedrite, spinel, pyrite, magnetite, and cuprite.

No. II. Tetragonal—also known as the *Pyramidal* and *Dimetric*.

Includes all forms which have three rectangular axes, of which the two lateral are equal, and the vertical one either shorter or longer.

Represented by: Cassiterite, zircon, idocrase, rutile, scheelite, and chalcopyrite.

No. III. Hexagonal—also known as the *Rhombohedral*.

Includes all forms having four axes, three equal lateral axes in a common plane intersecting at angles of 60°, and a vertical axis at right angles.

Represented by: Quartz, beryl, apatite, calcite, pyromorphite, siderite, hematite, tourmaline, and dolomite.

No. IV. Orthorhombic—also known as the *Trimetric*, *Prismatic*, and *Orthotype*.

Includes all forms which have three unequal axes at right angles to each other.

Represented by: Baryte, stibnite, arsenopyrite, anglesite, topaz, and cerussite.

No. V. Monoclinic—also known as the *Oblique* and *Hemi-orthotype*.

Includes all forms having three unequal axes with one of the axial inclinations oblique.

Represented by: Gypsum, orthoclase, augite, hornblende, muscovite, and crocoisite.

No. VI. Triclinic—also known as the *Anorthic*, *Double Oblique*, and *Anorthotype*.

Includes all forms which have three unequal axes, with all their intersections oblique.

Represented by: Axinite, labradorite, cyanite, rhodonite, albite, and anorthite.

ORES OF PRINCIPAL ECONOMIC MINERALS.

The following is a list of the more important ores of the principal economic metals recorded in this catalogue. For information as to their occurrence see under the headings of the respective minerals:—

- Antimony—
  - Antimony, Native
  - Cervantite
  - Stibnite
- Bismuth—
  - Bismuth, Native
  - Bismuthinite
  - Bismite
  - Bismutite
- Cobalt—
  - Asbolite
  - Cobaltine
  - Glaucodote
  - Smaltine
- Copper—
  - Copper, Native
  - Cuprite
  - Covellite
  - Chalcopyrite
  - Bornite
  - Chalcocite
  - Malachite
  - Melaconite
- Iron—
  - Hematite
  - Limonite
  - Magnetite
  - Siderite
- Lead—
  - Anglesite
  - Crocoisite
  - Cerussite
  - Galenite
  - Huascolite
  - Jamesonite
  - Massicot
  - Pyromorphite
  - Bindheimite
- Manganese—
  - Asbolite
  - Pyrolusite
  - Psilomelane

- Nickel—
  - Annabergite
  - Heazlewoodite
  - Millerite
  - Niccolite
  - Pentlandite
  - Zaratite

- Tin—
  - Cassiterite
  - Stannite

- Silver—
  - Silver, Native
  - Argentite
  - Cerargyrite
  - Embolite
  - Jamesonite
  - Stromeyerite
  - Sternbergite
  - Tetrahedrite
  - Stannite
  - Blende
  - Tennantite
  - Bindheimite
  - Galenite
  - Proustite

- Zinc—
  - Calamine
  - Huascolite
  - Mariatite
  - Sphalerite (Blende)

SCALE OF HARDNESS.

(MOHS'.)

Degree.	
1.	Talc
2.	Gypsum
3.	Calcite
4.	Fluorite
5.	Apatite (crystallised variety)
6.	Felspar (Adularia)
7.	Quartz
8.	Topaz
9.	Corundum
10.	Diamond

SCALE OF FUSIBILITY.

(VON KOBELL'S.)

1. *Stibnite.*—Fusible in candle flame in coarse splinters.
2. *Natrolite.*—Fusible in candle flame in fine splinters. Easily fusible before the blowpipe in coarse fragments.
3. *Almandine*, or Iron Alumina Garnet.—Infusible in candle flame, quite fusible before the blowpipe in coarse fragments
4. *Actinolite.*—Fusibility less than Almandine and greater than No. 5; fusible in coarse splinters.
5. *Orthoclase.*—Fusible in fine splinters.
6. *Bronzite.*—Only rounded on the edges in very fine splinters.

PRINCIPAL PHYSICAL PROPERTIES OF THE ABUNDANT AND IMPORTANT MINERALS OCCURRING IN TASMANIA.

(From " Frazer's Tables for the Determination of Minerals.")

Name.	Colour.	Streak.	Hardness.	Specific Gravity.
Arsenopyrite	Tin-white	Black	5·5	6
Barite	All colours, principally pale-red and yellow	White	3	4·3 to 4·7
Calcite	All colours, usually white	White	3	2·6
Cassiterite	Black, yellow, brown, and red	Light grey-brown	6·5	6·8
Chalcopyrite	Brass-yellow	Green-black	4	4·2
Galena	Lead-grey	Greyish-black	2·75	7·5
Gold	Gold-yellow	Gold-yellow	2·5	15·6 to 19·5
Hematite	Steel-grey to iron-black	Red	6·5	4·8
Jamesonite	Black lead-grey to steel-grey	Grey-black	2	5·7
Limonite	Brown	Yellow	4·5	3·7
Molybdenite	Lead-grey	Grey or green	1·5	4·6
Pyrite	Pale brass-yellow	Black	6·5	5
Pyrrhotite	Bronze-yellow	Black	4·5	4·5
Quartz	Colourless, white, and most colours	White, when coloured the same, but paler	7	2·7
Rutile	Black-brown	Light-brown	6·25	4·2
Siderite	Yellow to brown	Light-brown	4	3·8
Silver	Silver-white	Silver-white	3	10·5
Sphalerite (Zinc-blende)...	Black to brown	Brownish-black	4	4
Stibnite	Lead-grey	Black	2·5	4·5
Tetrahedrite (Fahlerz) ...	Lead-grey to brown-black	Black in part; inclined to cherry-red	3·5	4·5 to 5·1
Wolframite	Black	Red-brown	5	7·2

TABLE OF THE PRINCIPAL ELEMENTS, WITH THEIR SYMBOLS, ATOMIC WEIGHTS, SPECIFIC GRAVITIES, AND PRINCIPAL SOURCE.

Metals.

Names.	Symbols.	Atomic Weight.	Specific Gravity.	Principal Source.
Aluminium	Al	27	2·56	Beauxite
Antimony	Sb	120	6·72	Stibnite
Arsenic	As	75	5·67	Pyrites
Barium	Ba	137·2	4·0	Heavy spar
Bismuth	Bi	207·5	9·8	Bismuthinite
Cadmium	Cd	112	8·6	Blende
Caesium	Cs	132·9	1·88	Mineral waters
Calcium	Ca	40	1·6	Limestone
Cerium	Ce	140·2	5·5	Allanite
Chromium	Cr	52	5·9—6·8	Chromite
Cobalt	Co	58·07	8·957	Smaltine
Copper	Cu	63·2	8·8	Sulphides
Didymium	Di	142	6·5	Yttrocerite
Erbium	E	166	—	Gadolinite
Gallium	Ga	69·9	5·95	Blende
Germanium	Ge	72·3	5·469	Argyrodite
Glucinum	Gl	9·1	2·1	Beryl
Gold	Au	196 8	19·32	Native
Indium	In	113·4	7·4	Blende
Iridium	Ir	193·2	22·4	Osmiridium

Iron	Fe	56	7·86	Hematite
Lanthanum	La	138·2	6·2	Allanite
Lead	Pb	206·4	11·37	Galena
Lithium	Li	7	·58	Lepidolite
Magnesium	Mg	24	1·74	Magnesite
Manganese	Mn	54·8	8	Manganite
Mercury	Hg	200	13·59	Cinnabar
Molybdenum	Mo	96	8·6	Molybdenite
Nickel	Ni	58·6	8·8	Pentlandite and Garnierite
Niobium	Nb	94	6·27	Colombite
Osmium	Os	192	22·4	Osmiridium
Palladium	Pd	106·7	11·4	Platinoids
Platinum	Pt	194·3	21·5	Native
Potassium	K	39·1	·865	Carnallite
Radium	—	225	—	Pitchblende
Rhodium	Rh	103·1	12·1	Platinoids
Rubidium	Rb	85·4	1·52	Lepidolite
Ruthenium	Ru	104	11·4	Osmiridium
Silver	Ag	107·6	10·53	Galena and other ores
Sodium	Na	23	·972	Halite
Strontium	Sr	87·5	2·5	Strontianite
Tantalum	Ta	182·8	14·08	Tantalite
Thallium	Tl	203·64	11·8	Pyrites
Thorium	Th	232	11·1	Monazite and Thorite
Tin	Sn	117·4	7·3	Cassiterite
Titanium	Ti	48·1	—	Rutile
Tungsten	W	184	18	Wolframite and Scheelite
Uranium	U	239	18·7	Pitchblende
Vanadium	V	51	5·5	Patronite
Yttrium	Y	89	—	Yttrocerite

Table of the Principal Elements—*continued.*

Names.	Symbols.	Atomic Weight.	Specific Gravity.	Principal Source.
		Metals—continued.		
Zinc	Zn	65	7·15	Blende
Zirconium	Zr	90·7	4·15	Zircon
		Non-Metals.		
Argon	Ar	20	—	Atmosphere
Boron	B	11	2·68	Borax
Bromine	Br	79·76	2·96	Carnallite
Carbon, Graphite	—	—	2·2	Native
Carbon	C	12	—	
Carbon, Diamond	—	—	3·5	
Chlorine	Cl	35·5	—	Hydrochloric acid
Fluorine	F	19	—	Fluorite
Hydrogen	H	1	—	Water
Helium	He	2·13	—	Atmosphere
Iodine	I	126·54	4·95	Algæ or kelp, and Nitre
Nitrogen	N	14	—	Atmosphere
Oxygen	O	16	—	Atmosphere
Phosphorus	P	31	1·8—2·1	Bones
Selenium	Se	79	4·3—4·8	Selenides
Silicon	Si	28	2·47	Quartz
Sulphur	S	32	1·97—2·07	Native and pyrites
Tellurium	Te	125	6·1	Tellurides

The *Atomic Weight* is the weight of an element compared with the weight of hydrogen.
The *Specific Gravity* is the weight of an element compared with water.

THE PRINCIPAL CHARACTERS OF THE MORE IMPORTANT COMPLEX METALLIC SULPHIDES AND SULPHARSENIDES CONTAINING SB. AND PB.

	Crystallographic System.	Hardness.	Specific Gravity.	Sb.	Pb.	Fe.	Cu.	S.	As.	Colour.	Streak.	Remarks.
Zinkenite..	Pris.	3·35	5·30	44·00	31·84	...	...	22·00	...	Steel lead-grey	Same as colour	Brittle, radiating, columnar
Jamesonite	Pris.	2·25	5·60	33·00	39·00	3·00	...	21·78	...	„	„	Sectile, fibrous, diverging
Plagionite	Oblique	2·50	5·40	37·00	40·00	...	...	21·00	...	„	„	Granular masses, crystals
Boulangerite ...	...	3·00	6·00	25·00	53·00	1·00	...	19·00	...	„	Darker	Silky, brittle, fibrous
Geocronite	Pris.	2·50	5·80	16·00	64·00	...	1·60	17·00	Little	Lead-grey	„	Conchoidal, brittle
Berthierite	...	2·50	4·00	54·00	...	12·00	...	30·00	...	Iron-black	...	Uneven, with red or yellow tarnish
Wolfsbergite ...	Pris.	3·50	4·70	46·00	...	1·30	24·00	26·00	...	Dark lead-grey	Black	Conchoidal to uneven, cleaver-age perfect
Dufreynoysite...	Cubic	...	5·50	...	57·21	...	...	22·10	20·69	Steel-grey	Red-brown	Uneven, brittle
Bournonite	Pris.	2·50	5·70	26·94	41·80	...	12·70	19·37	...	Lead-grey	Same	Uneven, brittle
Wolchite	Pris.	3·00	5·70	16·68	29·00	1·40	17·35	28·60	6·00	Black lead-grey	Same	Imperfect, conchoidal
Kobellite	...	...	6·30	9·25	40·12	3·00	...	17·80	...	Lead-grey	Black	Bi 27, radiating, fibrous
Tennantite	Cubic	4·00	4·30	...	...	3·50	48·50	27·76	19·10	Black lead-grey	Reddish-grey	Uneven
Tetrahedrite ...	Cubic	3·00	45·50	23·00	...	4·00	38·00	26·00	2·10	Steel-grey	Black-red	Conchoidal, uneven, brittle
Patrenite.	Pris.	2·50	6·75	...	35·73	...	10·94	16·57	...	Black lead-grey, tarnish red	Same	Disseminated Bi 36
Meneghinite ...	Pris.	2·50	6·34	18·60	64·00	...	...	17·40	...	Black lead-grey	Black	Fibrous and slender crystals

NOTES ON THE PUBLICATIONS OF THE ROYAL SOCIETY OF TASMANIA.

BY FRITZ NOETLING, M.A., PH.D., ETC.

(Read 11th April, 1910.)

1. THE PUBLICATIONS OF THE TASMANIAN SOCIETY.

It appears that the first scientific society in Tasmania was started in 1838 under the auspices of Sir John Franklin. The name of this society is, however, somewhat uncertain. In the introductory remarks to the first volume of its transactions it was called "The Philosophical Society of Tasmania," but it does not appear that this name found favour, because subsequently the name "Tasmanian Society" was adopted. The object of this society was the study of natural science, in particular that of Tasmania. Under the title, "Tasmanian Journal of Natural Science, Agriculture and Statistics,' etc., this society published three volumes of transactions, viz., Vol. I. (1842), Vol. II. (1846), Vol. III. (1849).

In the meantime two societies, having more or less the same object in view, were started, viz., on the 14th of October, 1843, the Botanical and Hortcultural Society of Van Diemen's Land, and on the 12th of September, 1844, "The Royal Society of Van Diemen's Land." It looks somewhat strange that in so small a community as Hobart was at the beginning of the forties, there should be room for three scientific societies; but notwithstanding this it is certain that between 1843 and 1849 there existed in Hobart three scientific societies, viz., (1) The Tasmanian Society (1838); (2) The Botanical and Horticultural Society of Van Diemen's Land (1843); The Royal Society of Van Diemen's Land (1844). As it might have been expected, there was no room for three societies working practically on the same lines. The Botanical and Horticultural Society never issued any publications, and the Royal Society only published annual reports for the years 1845 to 1849. Apparently towards the end of

1849, or early in 1850, the three societies amalgamated, or, to be more correct, the "Tasmanian Society" and the Botanical and Horticultural Society were absorbed by the Royal Society of Van Diemen's Land. Though the Royal Society did not issue any Journal till May, 1849, its year of birth was in 1844, and it is therefore in its sixty-sixth year.

2. PUBLICATIONS OF THE ROYAL SOCIETY OF VAN DIEMEN'S LAND.

Though the older society went under the name of "Tasmanian" Society, and its publication was called the "Tasmanian" Journal, this name did not survive, probably because the official name of the island was Van Diemen's Land.

During the first four years of its existence the Royal Society published annual reports only (1845 to 1848 inclusive), and during these years the Tasmanian Journal, though issued by a sister society, was practically the publication of the Royal Society.

Towards the end of 1848, or early in 1849, the Council of the Royal Society decided to publish a periodical journal under the title, "Papers and Proceedings of the Royal Society of Van Diemen's Land." The first part of the first volume was issued in May, 1849; therefore, the last volume of the Tasmanian Journal, and the first part of the first volume of the Papers and Proceedings of the Royal Society of Van Diemen's Land were published in the same year, the latter apparently succeeding the former.

The next volume of the "Papers and Proceedings" was issued as Part II. of Volume I. in January, 1850, and from now a yearly volume was published up to 1855 inclusive. Unfortunately a very bad plan was adopted in numbering the publications. The journal issued was an annual publication, but the volumes were not. Three annual parts, published in three succeeding years, formed one volume. This led subsequently to a great confusion, which became worse, because no separate title pages or table of contents were issued for the volume. With the exception of Part I. of Vol. I., the table of contents were printed on the back cover, and in binding the volume it is therefore imperative that the covers should be preserved.

The Royal Society of Van Diemen's Land during the eleven years of its existence has issued the following publications:—

(a) Annual Report, 1845 to 1855 (11 numbers).

(b) Papers and Proceedings, 1849 to 1855 (7 annual volumes), viz.:—Vol. I., part 1, May, 1849; part 2, January, 1850; part 3, January, 1851; Vol. II., part 1, January, 1852; part 2, January, 1853; part 3, January, 1854; Vol. III., part 1, 1855.

It appears that the Annual Report was not intended to form a portion of the society's scientific publications, because it was issued separately; the Papers and Proceedings of the Royal Society of Van Diemen's Land are therefore complete without the Annual Report, while this is not the case with some later publications.

3. PUBLICATIONS OF THE ROYAL SOCIETY OF TASMANIA.

By Act of Parliament in 1856 "Van Diemen's Land" was henceforth to be known as "Tasmania," and as the new name automatically replaced the old one wherever it occurred, the Royal Society of "Van Diemen's Land" became the Royal Society of "Tasmania."

This change apparently upset the arrangements for the publications of the Papers and Proceedings, and though in their Annual Report for 1856 the Council state "that Part 2 of Volume III. of the Papers and Proceedings is now in the Press, and will appear as speedily as possible," it was not issued till three years later, in 1859. It was then published under the title, "Papers and Proceedings of the Royal Society of Tasmania, Vol. III., Part II., 1859."

The inconvenience of the original arrangement of issuing three-yearly volumes instead of annual ones becomes now obvious, because the above title is unquestionably a misnomer. The Royal Society of "Tasmania," whose year of birth is 1856, had only published Annual

Reports for the years 1856 to 1859, but it had not issued a journal during these years. It is therefore not correct to call the first journal issued by the Royal Society of Tasmania "Part 2 of Vol. III." The first part of this Vol. III. bears the title "Papers and Proceedings of the Royal Society of Van Diemen's Land," and we therefore see that Vol. III. consists of two parts—Part 1 (1855), Part 2 (1859)—bearing two different titles. The intention was apparently to conclude Vol. III. of the Papers and Proceedings of the Royal Society of Van Diemen's Land, but as in the meantime this word had been replaced by "Tasmania," there was no other way out of it except to call Part 2 of Vol. III. Papers and Proceedings of the Royal Society of "Tasmania." From a bibliographical point of view this is very misleading, and nobody who is not well acquainted with all the circumstances surrounding the publication of this Vol. III. would understand its quaint composition.

The publication of this volume for 1859 seems to have exhausted the energies of the Royal Society, because no journal, but only Annual Reports, were issued for three years, viz., 1860, 1861, 1862.

In 1863 the first volume of a new periodical publication, called "Monthly Notices of the Papers and Proceedings of the Royal Society of Tasmania," appeared, and continued to be published under this title till 1875. The volume for 1863 is somewhat of a curiosity, because its first and second "monthly notice" contain papers that were read in 1860 and 1862 respectively. In 1863 a number, paged separately, was issued every month, but the first three numbers do not bear the name of the month, which is to be found on the April to December numbers only. If the covers of these numbers are removed, the volume contains twelve pages 1, twelve pages 2, and so on.

In order to avoid this obvious inconvenience, the volume for 1864 was consecutively paged. Separately from the "Monthly Notices" the Annual Report was issued as a special pamphlet till 1868.

In 1868 the Annual Report was issued, together with the Papers and Proceedings, the volume showing consecutive paging throughout. This lasted till 1875 inclusive, but in the meantime the Monthly Notices were issued in a different form. Instead of being published every month they appeared every three months, the quarters being March, April, May—June, July, August—September, October, November—no Monthly Notices being issued for December, January, February. This practice was started in 1870; the exact year is not quite known; it may have even commenced in 1869, or even 1868, but this is not quite certain, and it continued till 1875, when a slip appended to the September, October, November number informed the Fellows that in future the Proceedings would be issued in a yearly volume, complete, with index, etc., instead of quarterly as hitherto. The year 1875 closes therefore the first period of the publication issued by the Royal Society of Tasmania since its change of name. Its publications are:—

1856, 1857, 1859—Annual Reports only; no Papers and Proceedings.

1859—Papers and Proceedings of the Royal Society of Tasmania, forming Part 2 of Vol. III. of the Papers and Proceedings of the Royal Society of Van Diemen's Land.

1860, 1861, 1862—Annual Reports only; no Papers and Proceedings.

1863 to 1875 inclusive—Monthly Notices of the Papers and Proceedings of the Royal Society of Tasmania.

1863—Separate paging of each number; issued monthly.

1864-1869—Consecutive paging; issued monthly.

1870-1875—Consecutive paging; issued quarterly.

The Annual Reports were issued separately from 1863 to 1866; from 1867 to 1874 it was included with the Papers and Proceedings and consecutively paged; in 1875 it was again separately paged.

The second period begins with the year 1876, when the old practice of the Tasmanian Society and the Royal Society of Van Diemen's Land, to issue annual volumes only, was resumed. These appeared under the title—

> "Papers and Proceedings and Report of the Royal Society of Tasmania."

Though the title indicated that the Journal was to include the Annual Report, the latter was paged and published separately from the Papers and Proceedings. The new title was in use for six, or, if we include 1875, for seven years only, being perhaps too cumbersome; the words "and Report" were omitted in 1882, and the pubication now became—

> "Papers and Proceedings of the Royal Society of Tasmania,"

a title which has been retained ever since. Strictly speaking the title ought to be "Papers and Proceedings of the Royal Society of Tasmania, New Series," because we have seen that as far back as 1859 a volume was published under this title.

From 1882 to 1885 the Annual Report was bound with the Papers and Proceedings, though paged separately; from 1886 to 1889 inclusive it was published separately, and not issued together with the Papers and Proceedings; in 1890 and 1891 it was again issued with the Papers and Proceedings; while in 1892 it was again published separately. No Annual Reports were issued for the years 1893 to 1907 inclusive; but since 1908 the practice of publishing an Annual Report, bound with the Papers and Proceedings, though separately paged, has again been taken up.

Since 1894 and up to 1908 the publication of the Papers and Proceedings became somewhat erratic. Instead of annual volumes, one volume only was issued for the years 1894-95, 1898-99, 1900-01, 1903-05, 1906-07. The total number of volumes published by the Royal Society since 1863 up to 1909 inclusive is therefore 42, instead of 47, viz.:—

1876-1881—Papers and Proceedings and Report of the Royal Society of Tasmania (Annual Report paged separately).

1882-1909—Papers and Proceedings of the Royal Society of Tasmania.

Annual Report, 1882-85, bound with Papers and Proceedings, but paged separately.

Annual Report, 1886-89, issued separately.

Annual Report, 1890-91, bound with Papers and Proceedings, but paged separately.

Annual Report, 1892, issued separately.

No Annual Report for 1893-1907.

Annual Report, 1908-09, bound with Papers and Proceedings, but paged separately.

The above researches have proved that the publications of the Royal Society and its predecessors have undergone various changes, and that it is by no means easy to follow them. A complete set should contain:—

A.—Journal and Papers and Proceedings.
- I. Tasmanian Society.
  Tasmanian Journal, 3 vol., 1842, 1846, 1849.
- II. Royal Society of Van Diemen's Land.
  Papers and Proceedings, 7 vol., 1849-1855.
- III. Royal Society of Tasmania.
  - (a) Papers and Proceedings, Part 2, Vol. III., 1 vol., 1859.
  - (b) Monthly Notices of Papers and Proceedings, 13 vol., 1863-1875.
  - (c) Papers and Proceedings and Report, 6 vol., 1876-1881.
  - (d) Papers and Proceedings, 23 vol., 1882-1909.

B.—Annual Reports.
- I. Tasmanian Society, nil.
- II. Royal Society of Van Diemen's Land, 11 numbers, 1845-1855.
- III. Royal Society of Tasmania, 39 numbers, 1856-1909.

The grand total of the publications since 1842 is therefore

Journal, Papers and Proceedings ..	53 volumes
Annual Reports	50 numbers

extending over a period of 68 years from 1842 to 1909. The volumes may not have been very bulky, but they contain an enormous amount of scientific research, and they are an everlasting memorial to those enthusiasts who diligently worked in those years when communication with the scientific centres of the world was not as easy as it is nowadays. In 1912 we will be able to celebrate the 70th anniversary of the first scientific Journal published in Tasmania—in fact, if I am not very much mistaken, of the first scientific Journal published in Australia, and two years later the Royal Society of Tasmania will look back on 70 years of scientific work.

THE ANTIQUITY OF MAN IN TASMANIA.

Pl. I. and II.

By Fritz Noetling, M.A., Ph.D., etc.

(Read April 11th, 1910.)

1. INTRODUCTORY REMARKS.

There exists in Tasmania perhaps the greatest unconformity in the history of evolution of the human race that we know of. Modern civilisation follows immediately on the most typical archaeolithic stage that is known to us. All intermediate stages which we observe in other countries are missing in that island. From this point of view it was fortunate that the contact between the lower and the higher civilised race lasted for such a short time only. Not thirty years lapsed between the first encounter at Risdon ferry and the final deportation of the Aborigines to Flinders Island. This time was not long enough to adulterate the archaeolithic civilisation by the introduction of foreign ideas. However deplorable it may be that the Aborigines died out so rapidly, there is at least one consolation in their fate —their civilisation has been delivered to us in all its characteristic features. But we have to thank another lucky accident for this, viz., the insular seclusion of Tasmania. On the eastern, southern, and western coast we find abysmal depths within a few miles from the shore. The 500-fathom line is hardly more than 30 nautical miles from the land. Only in the north of the island we notice shallower water. Nowhere in Bass' Straits between Hunter's Island in the west and Cape Portland in the east, Tasmania in the south and Australia in the north, does the depth exceed 50 fathoms (1).

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(1) In the south the coast drops within two miles from the shore to 61 fathoms depth.

While in the west, south, and east the nearest land is thousands of miles distant, the north coast of Tasmania is in a straight line about 184 miles from the coast of Victoria. We therefore have an area absolutely isolated from the remainder of the world, and it is only thanks to this isolation that the Tasmanian race has been preserved as long as it had been. We may safely assume that had there been any connection whatsoever between Tasmania and Australia before the arrival of the Europeans, the Aborigines would have been wiped out by a superior race long before we ever knew of their existence. We may now well raise the question, how did the Tasmanians get into their island country? As they cannot have arrived in boats or canoes, they must have arrived over a land route. We know sufficiently enough of their habits that it is a certainty that they could not build any canoes or boats worthy of that name. The fabrics that go under this name are nothing more than bundles of reed and grass tied together with a grass rope. These structures might serve to cross a river, or to reach Bruny or Maria Island from the Tasmanian coast, but it would be more than absurd to assume that the Tasmanians navigated a stormy sea on these reed bundles without sails and paddles. The best proof, if any such would be required to support this view, is the transportation of the last remains of the race to Flinders Island. Had there been the faintest idea that they could construct serviceable canoes, by means of which they might manage to escape, they would certainly not have been sent to Flinders Island. But nobody seems to have entertained even the faintest notion that such could be possible. Davies (1) in his valuable account of the Aborigines, says:—"This (viz., their reduced number) may have been in a great measure owing to their change of living and food, but much more so to their banishment from the mainland of Van Diemen's Land, which is visible from Flinders Island; and the natives have often pointed it out to me with expressions of the deepest sorrow depicted on their countenances."

Had the Aborigines really possessed the faculty to construct serviceable boats, surely they would have built such in order to escape from a place which was apparently detestable to them in order to reach their beloved old home.

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(1) The Aborigines of Van Diemen's Land, Tasm. Journ. of Nat. Science, 1846, Vol. II., pag. 419.

It is therefore more than certain that they must have arrived at a time when present Tasmania was connected with some other outside region. If we assume that the Aborigines came from some more southern region, we must presume the existence of an antarctic land free of ice and snow, and that there existed a continuous stretch of land from Tasmania to the South Pole. If such land existed it would be absurd to assume, in face of the depths that have been recorded north and south of the island, that Tasmania was not also connected with the continent of Australia. Some faddists favour this theory, but is it probable that when all these enormous changes took place that resulted in the glaciation of the antarctic, and the creation of a deep ocean where hitherto land had been, the Tasmanians peacefully remained in the island? It is much more probable to assume that when the first earthquakes shook the surface, when large tracts of land suddenly disappeared under the infuriated waters of the ocean, when volcanoes were belching forth their fiery streams of lava, they fled in mortal terror in that direction which was the safest, namely, towards north. Unless we believe that within 24 hours a catastrophe occurred that turned Tasmania from being part of a continent into an island, whose inhabitants, either human or animals, were thus cut off from all retreat without a moment's notice, the theory of immigration from the south is untenable. Even if this were probable, or even possible, we will see later on that all the survivors would have miserably perished of cold and hunger, and Tasmania would have remained uninhabited either by human beings or animals. Similar arguments apply to the theory of immigration from the east or west. There remains, therefore, only one direction from which the Aborigines can have come, viz., the north—that is to say, from the continent of Australia. At the present day a shallow, rather narrow, strait separates Australia and Tasmania, but it is still broad and deep enough to prevent even the Aborigines of Victoria, who understand how to construct serviceable boats far superior to the grass bundles of the Tasmanians, from reaching this island. Is it probable to assume that the lower Tasmanians succeeded where the more intellectual and higher civilised Victorians failed? Even if they had achieved the improbable, why did they not keep in communication with the mainland? It would be waste of space to discuss these questions any further; everything tends to prove that the Aborigines must have arrived in Tasmania when a land bridge or isthmus connected the island with the continent.

Are we in the position to fix the time when Tasmania was still connected with the mainland, and can we also fix the time when the separation took place? We can say that the time of separation fixes the time of immigration, because the latter must have taken place before, but cannot possibly have happened after the former.

The question is essentially a geological one, and can only be answered by a geologist. I will here attempt to give a solution, based on my studies of the Admiralty chart of Bass Straits, and geological observations in all parts of Tasmania.

2. HISTORICAL SUMMARY.

If I am not mistaken Howitt (1) was the first who attempted to solve the problem of the origin of the Tasmanian race and the time of their migration to the present island. Of course, I mean that the problem was treated in a scientific way, because the number of idle speculations is legion. Howitt's paper begins with a valuable review of all older views regarding the origin of the Australians, of which the Tasmanians were to be considered a branch only, and he arrives at a very important conclusion with regard to the Tasmanian race. He says, l.c. pag. 730:—" But there is not a tittle of evidence in support of the belief that the Tasmanians ever were acquainted with the art of constructing a canoe able to cross such a sea-strait as that between Tasmania and Australia." And further on:—" I have long since come to the conclusion that one of the fundamental principles to be adopted in discussing the origin of these savages must be that they reached Tasmania at a time when there was a land communication between it and Australia." And further:—" From the conclusions to which I have now been led, it follows that the Tasmanians were the autochthonous inhabitants of Australia, and that their preservation in Tasmania was due to isolation by the formation of Bass Strait (l.c. pag. 741).

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(1) On the origin of the Aborigines of Tasmania and Australia. Report on the seventh meeting of the Australasian Association for the Advancement of Science, Sydney, 1898, Sect. F., Ethnology and Anthropology, pag. 723-758.

Howitt is therefore of the opinion, and this is perhaps one of the most interesting conclusions, that the Tasmanian Aborigines inhabited the Australian continent before the immigration of those races that now dwell there. If this be so, and I for one fully support this theory, we must assume that there existed in Australia at least two, if not three, stone ages. The first and oldest represents the archaeolithic stage of the Tasmanians, which was superseded by the palaeolithic-neolithic (1) stage of the Australians. It follows that when stone implements are collected in Australia the greatest care must be taken, in order to ascertain to which stage they belong. Howitt's theory assumes that the Tasmanians inhabited the Australian continent, and if that be so they must have left the same remains behind as they did in Tasmania. Shell heaps in which only archaeolithic implements occur, camping grounds on sandy soil where the same implements are found, should always be suspected to represent relics of the autochthonous and not of the younger race (2). Howitt's geological conclusions are, however, of the greatest importance. He assumes that:—

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(1) I cannot enter here in the discussion of the question whether there is a true palaeolithic stage in Australia, such as we know to exist in Europe, or whether the Australian civilisation has to be considered as a neolithic stage, with a strong admixture of palaeozoic types.

(2) It is difficult to understand how, in direct contradiction to this well-supported theory, Herr Klaatsch could arrive at the conclusion that it was impossible to distinguish in Australia the different stages recognised in Europe, and that types of implements which in Europe occur in different chronological stages occur in Australia simultaneously. Nobody doubts that implements of the archaeolithic type were still used in neolithic or even later periods, but it is quite certain that there exist in Australia in at least two periods, which represent chronological stages, and which are characterised by implements of a different type. Herr Klaatsch's view is one of those numerous superficial and hasty judgments by which this author has obtained an unenviable notoriety. Perhaps Howitt's paper was unknown to him.

(a) The isthmus between Tasmania and Australia existed during the younger volcanic period.

(b) The dingo did not exist during this time in Victoria, otherwise it would have migrated with the Tasmanians into the island.

(c) The land-connection between Australia and Tasmania was interrupted when Diprotodon and the other gigantic marsupials existed on the Australian continent. (See pag. 24.)

A few years later C. Hedley (1) carefully discusses the question, and what effect the so-called Bassian Isthmus would have on the marine fauna. Though Hedley's paper does not bear on the question of the immigration of the Aborigines, it is of the greatest importance with regard to this problem, because it presumes the existence of a land connection between Tasmania and Australia in recent times. Hedley points out the difference in the marine fauna east and west of Wilson's Promontory, and his lists of the Adelaidian (west) and the Peronian (east) fauna prove conclusively that there exists a vast difference. Such a faunistic difference in an open sea can only be accounted for by the existence of a former barrier of land which prevented the interchange of the faunas. I think there can be no difference of opinion on this point. The sketch map accompanying Mr. Hedley's paper is, however, erroneously constructed, because he assumes that the isthmus connected only the eastern part of Tasmania with Australia. This is certainly wrong, as a consultation of the Admiralty chart would have shown him. The southern continuation of Tasmania as constructed by Mr. Hedley is more than problematical; it is certainly not borne out by the soundings marked on the chart. However, this does not detract from the great importance of Hedley's conclusion that a land connection must have existed between Tasmania and Australia within such a recent period, that there was not time enough for a mixture of the two faunas east and west of that bridge, but that the two are as separate as if the isthmus still existed.

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(1) The effect of the Bassian Isthmus upon the existing marine fauna: a study in ancient geography. Proceed. Lin. Soc. of New South Wales, 1903, Pl. iv., pag. 876-883.

3. THE SUBMARINE TOPOGRAPHY OF BASS STRAIT.

Independently of Howitt, my own studies into the civilisation of the Aborigines have led me to assume that their immigration must have taken place at a time when Tasmania and Australia were connected by a land bridge. I went, however, somewhat further than Howitt, who only constructed the 50 and 100 fathom line. I argued if such a bridge existed, the submarine topography of Bass Strait should reveal us its features provided we assume that the sea level rose and water covered previously existing land. I consulted the Admiralty chart, which contains a wonderful mass of information, and after a good number of failures I succeeded in drawing the isobathic lines from 5 to 5 fathoms.

In order to fully understand the changes, we will begin with the appearance of Bass Strait at the present day. We will then assume the sea level to subside to the 20-fathom line, because the changes in the contour between the 0 and 20 isobathe are very small. We will then follow up the changes that take place when the sea level gradually recedes to the 25, 30, 35, 40, 45, and 50 fathom line.

(a) BASS STRAIT AT THE PRESENT DAY.
(PLATE I., FIG. 1.)

Bass Strait of the present day has a curious elliptical form; its longest axis runs almost due north-west to south-east, and its length between Cape Otway and Cape Portland is approximately 345 miles. The smaller axis from Hunter's Island to Wilson's Promontory measures about 184 miles. The total area of Bass Strait within the boundaries presently described can be estimated at 60,994, say 61,000 square miles.

The southern boundary is formed by the north coast of Tasmania, beginning at 144deg. 50min. long., and extending for about 200 miles towards east, where Cape Portland, about 148deg. long., marks its eastern end. The most conspicuous feature of Tasmania's north coast is the very regular concave line it forms; its lowest point is about between the rivers Leven and Forth, while the eastern and western ends extend 40 and 30 miles respectively above this point in northern direction.

The opposite (northern boundary) is formed by the south coast of Victoria from Cape Otway (143deg. 35min. long.) to Wilson's Promontory (146deg. 25min. long.). This boundary is almost the exact counterpart of the southern one; its total length is the same, about 200 miles, and, like the former, it is concave, with that difference, however, that the eastern end (Wilson's Promontory), instead of the western, reaches further towards south (about 50 miles) above the lowest point.

The eastern and western boundaries are much less continuous, only a few remnants being still in existence.

In the west we have Robins', Hunter's, and Three Hummock Islands; a little further towards north-west are the rocks Black Pyramid, Albatross Island, and the Reid Rocks. The latter are on the south-east corner of King Island, which marks the last piece of the western boundary.

In the east the number of remnants is much larger; close to Tasmania we have the Furneaux Islands, followed by numerous islands and rocks, of which we only need to mention the Curtis, Kent, and Hogan groups.

(b) THE 20-FATHOM LINE.
(PL. I., FIG. 2.)

If the sea level were to subside to the 20-fathom line we would find that the north-east corner of Tasmania forms a broad peninsula, whose point is slightly curved towards west. Flinders Island, the Sisters, Badger, Barren, and Clark islands are connected with Tasmania. A fjord cuts deeply into the southern part of this peninsula. The north coast has only slightly increased.

In the north-west corner, Hunter's, Three Hummock, and Robins' Islands are connected with the mainland, but we observe that this peninsula reaches much less towards north than the eastern one.

The east coast of King Island sends out a curious two-pronged peninsula, while the west coast shows hardly any changes.

The Australian coast is not much altered in the south, but in the east it has considerably grown.

(c) THE 25-FATHOM LINE.
(PL. I., FIG. 2.)

A further receding of 5 fathoms produces the following changes:—The eastern peninsula has become much broader, and has particularly grown on its western shore. The deep channel in the south has disappeared, and all rocks and islands between Tasmania and Australia have considerably grown in size, in particular the Kent' Group.

The north-west corner of Tasmania sends out a long, narrow peninsula running straight towards north, and a somewhat shorter one in north-western direction, by which the Black Pyramid and the Reid rocks are joined to Tasmania.

King Island continues to increase in size in eastern direction, and in a similar way as Tasmania it sends a long, rather broad peninsula towards north. King Island and Tasmania are now separated by a very narrow strait of not more than 30 feet in depth.

The changes of the Australian coast and the north coast of Tasmania are insignificant.

(d) THE 30-FATHOM LINE.
(PL. I., FIG. 4.)

A further subsidence of the sea level of 5 fathoms produces great changes. The Kent group and the Wright rocks have joined the eastern peninsula, and a narrow isthmus, which is not raised more than 30 feet above sea level, joins Tasmania with Australia. This eastern isthmus is still very broad and compact in the south, but very narrow in the north, where it is deeply cut into by gulfs and bays.

The north coast of Tasmania shows no great changes. On the other hand, the north-western peninsula has considerably grown, and King Island has joined Tasmania. A large peninsula extends therefore from the north-west corner of Tasmania in northern direction close to the mainland of Australia. A rather winding channel, which in the whole takes a south-westerly direction, cuts deeply into this peninsula, dividing it into two parts. The south coast of Australia has not grown very much, but the land has greatly increased in eastern direction.

We have therefore a large inland lake or basin between Tasmania and Australia, which is connected with the open ocean near the Australian coast by a narrow strait of about 30 feet in depth. We already perceive that this basin is unquestionably divided into two parts.

(e) THE 35-FATHOM LINE.
(PL. I., FIG. 5.)

The eastern isthmus continues to grow in breadth, but in the north there is still a deep bay, which reaches nearly up to the Kent Group.

The western peninsula has greatly increased in size; though still existing, the south-western channel is considerably reduced in breadth. The inland sea is still connected with the ocean, but the depth of the strait is considerably reduced; the division into two parts is now plainly marked.

(f) THE 40-FATHOM LINE.
(PL. I., FIG. 6.)

When the sea level has reached the 40-fathom line the western peninsula joins the mainland of Australia, and within the broad isthmus now connecting Tasmania and the mainland there appears a true inland lake, having an area of 9,944, say 10,000 square miles; that is to say, about the size of Lake Erie. This lake has no outlet into the open ocean, and it is distinctly divided into two portions—a southern and a northern one. The southern portion is the larger, and its greater axis runs almost due north-south. The eastern and north-eastern shore show numerous bays and fjords. The northern portion is much smaller, and its larger axis runs north-west to south-east.

(g) THE 45-FATHOM LINE.
(PL. I., FIG. 7.)

We will now assume that if the sea level on both sides of the isthmus recedes another 5 fathoms, the level of the inland lake will do the same. Of course, this need not be so; it is quite possible that though the level of the open ocean still receded that of the inland lake remained stationary; but for the sake of argument we will assume that the level of the inland lake followed that of the open ocean.

The inland lake, as it would be shown by the 45-fathom line, represents a basin whose main axis bears north-west to south-east. A line from the mouth of the Tamar to Port Phillip almost coincides with the direction of this line. A large, narrow stretch of land which extends from the western shore, and which is nearly met by another one from the eastern shore, subdivides the basin into two parts, which communicate only by means of a narrow and shallow strait. In fact, it is quite probable that the two basins are separated. In this part of Bass Strait the soundings are not very numerous, and the course of the 45-fathom line is therefore somewhat hypothetical. However that may be, whether connected or separate, the southern basin is the larger, and it is almost of circular shape, its main axis bearing almost due north-south. The main axis of the smaller northern basin is turned in westerly direction, and bears north-north-west-south-south-east. The area of the basin is 4,508, say 4,500 square miles.

A further receding of the water level of 5 fathoms would even lay this lake dry, provided that the level of the inland lake follows that of the open ocean.

If the level of the inland lake would not follow that of the open ocean we would have the features shown in Fig. 8, Pl. I., supposing the outer ocean had receded to the 40-fathom level.

A broad isthmus would connect Tasmania and Australia. The largest width of this isthmus would be under 40deg. lat., and it would extend from 144deg. long. to about 148deg. 55min. long.: that is to say, for about 345 miles. The east coast of this isthmus would be monotonous without deeper bays. The west coast shows, however, a large bay cutting into the land up to 145deg. long., being separated from the inland lake by a narrow and low ridge. South of King Island there are three broad bays. In the centre of the isthmus is a large inland lake, which in the south reaches almost to the present coast of Tasmania, while in the north it is close to the Australian coast. From the eastern ocean this lake is separated by a broad land bridge, whose highest point in Flinders Island is at least 1,400 feet above sea level, while the lowest elevation is not less than 300 feet above sea level. The bridge which separates the lake from the western ocean is, on the whole, somewhat broader than the eastern one, but it is joined to the mainland of Australia only by a very narrow strip of land hardly raised above sea level. A winding but narrow channel reaches from the west shore close to the Black Pyramid, where again only a narrow strip of land separates it from the open ocean. All the rivers of the north coast, from Montagu River in the west to the Ringarooma in the east, which now discharge their water into Bass Strait, would run into this lake. From Victoria we would have the Snowy and Mitchell Rivers, as well as a number of smaller ones, but Port Phillip would discharge into the open ocean. In all probability this lake would be saline, being without an outlet, a fact which is of some importance, as we shall see later on.

4. THE AREA OF THE DIFFERENT STAGES DESCRIBED IN PARAGRAPH 3.

We can express the increase of land if the sea level were to recede from 0 to 50 fathoms in absolute figures, as shown in the following table:—

THE AREA OF THE LAND APPEARING ON THE SURFACE, WERE THE SEA LEVEL IN BASS STRAIT TO RECEDE TO THE 20 FATHOM LINE AND THEN FOR EVERY 5 FATHOMS UP TO THE 45 FATHOM LINE, IN SQUARE MILES.

	Present Level.	20 Fathom Line.	25 Fathom Line.	30 Fathom Line.	35 Fathom Line.	40 Fathom Line.	45 Fathom Line
Total Area of Land (1)	10,855	17,771	23,735	29,752	37,392	47,999	57,200
(*a*) Australia	5,038	7 027	7,690	10,177	10,677		
(*b*) King Island	425	1,462	2,519	6,493	9,993	47,999	57,200
(*c*) Western Islands	102	1,194	2,519				
(*d*) Eastern Islands	1,047	3,182	5,701	7,676	10,676		
(*e*) North Coast of Tasmania	0	663	1,063	1,163	1,803		
(*f*) Tasmania	4,243	4,243	4,243	4,243	4 243		
Total Area of Water	61 196	54,280	48,316	42,298	34,659	24,057	14,851
(*a*) Ocean	61,196	24,314	23,653	18,961	15,646	14,108	10,343
(*b*) Bass Straits (Lake)		29,966	24,663	23,337	19,013	9,949	4,580
Area of Isthmus	—	—	—	—	—	47,093	50,853
(*a*) Land	—	—	—	—	—	37,144	46,345
(*b*) Water (Lake)	—	—	—	—	—	9,949	4,580

(1) As shown in the map.

Before going into details I wish to say a few words with regard to my calculations. I have no such instruments which are generally used in the calculation of the area of surfaces; I constructed therefore a network of squares, each having an area of 100 nautical square miles, and by means of these I could estimate the area of each stage. The values so obtained I converted into ordinary square miles, and this being done by logarithms, the figures appear to be painfully correct, though in fact they represent estimates only. Nobody will dispute that, considering the crude method, I might, for instance, just as well have written 10,000 instead of 9,993 square miles. It would perhaps have been much better had I given round figures, but this would have again required all sorts of corrections in order to make the aggregate of water and land agree with the area of the map. I therefore preferred to give the figures as I obtained them, leaving it to somebody better equipped than I am to obtain more accurate ones. I may, however, say that a check of the area of the islands which is known and the area obtained by my method give a difference of only 20 square miles, a result which is very satisfactory considering the crude method used.

We find that the actual increase of land for every 5 fathoms changes considerably, and in the following table I give it in absolute figures and in per cents.:—

Fathoms.	Total area of land in sqr. miles.	Actual increase sqr. Miles.	Per cent. of the preceding area.
0 to 5	17,771	6,916	—
5 to 10			
10 to 15			
15 to 20			
20 to 25	23,735	5,964	—
25 to 30	29,751	6,017	25.351 per cent.
30 to 35	37,392	7,640	25.679 per cent.
35 to 40	47,969	10,607	28 367 per cent.
40 to 45	59,200	9,207	19 169 per cent.
45 to 50	63,780	6,580	11.503 per cent.

This table wants also a few words of explanation. I mentioned above that the changes which take place if the sea level were to recede from 0 to 5, from 5 to 10, from 10 to 15, and from 15 to 20, are comparatively small, though on the whole the receding from 0 to 20 fathoms produces an increase of the land of 6,916 square miles. The average increase per 5 fathoms would therefore be 1,729 square miles. It is, however, very probable that the actual increase from 0 to 5 fathoms is less, and that from 15 to 20 fathoms considerably higher, than the average. It is, however, impossible to give even fairly accurate estimates, because the rate of increase apparently does not follow a regular law. We see that between 25 and 40 fathoms it increases, and from 40 to 50 fathoms it decreases again.

For the same reason it is impossible to give the correct ratio in per cents. We may say 6,916 square miles, representing in the aggregate 63.172 per cent. of the land shown in the map, have been added to it; but if I were to add only a short strip of land both to Australia and Tasmania, this would in no way alter the addition to the coast line, but it would at once alter the percentage.

The same argument applies to the increase between the 20 and 25 fathom line. We know the absolute increase in square miles, but nothing of the area of the 20-fathom line is known, except that it must be larger than 10,855, but smaller than 17,771 square miles; a percental figure cannot be calculated.

The average increase of land between 0 and 50 fathoms is 5,293 square miles for every 5 fathoms of depth, but it is clearly shown during the different stages that the ratio of increase varies considerably. The greatest increase takes place between the 35 and 40 fathom line, and thence it decreases in both directions. This plainly indicates one fact; the agencies responsible for the change of land into water have been increasing in force, first slowly, then quicker, till the maximum was reached between the 35 and 40 fathom line, and then their energy commences to decrease again. We will see later on that this fact deduced from the increase or decrease of area as the case may be is fully corroborated by certain geological changes known to us.

5. THE CAUSES THAT PRODUCED THE FORMATION OF BASS STRAIT.

The successive pictures as revealed to us of the submarine physiography of Bass Strait, should the sea level gradually recede from 0 to 45 or 50 fathoms, point conclusively to the agencies to which these features are due. The submarine features of Bass Strait are unquestionably not of primary origin, that is to say, they did not exist before the submergence of the isthmus. The features of present-day Bass Strait already indicate clearly enough that its origin must be due to dynamic agencies. In fact, Bass Strait can be considered almost as a model of a basin of subsidence. Segments of the earth's crust commenced to subside, slowly at first, more rapidly afterwards, the force rapidly gaining in energy till the maximum was reached, and then slowly decreasing again.

All geological observations tend to prove that an area of subsidence is accompanied by volcanic outbursts, either within the area or along its edges. Evidence of an intensive volcanic action is common enough along the coasts of Bass Strait. It would go too far to enumerate all the occurrences, but the submarine features, together with its present outline, and the geological evidence of the coast, prove conclusively that Bass Strait was formed by the subsidence of portions of the earth's crust, accompanied by volcanic outbursts.

If this be so, the inland lake as depicted, Pl. I., Fig. 8, probably never existed; that is to say, when the first subsidences commenced, ashes were thrown up, craters were formed emitting lava streams, but as the subsidence continued a large bay was formed, even before any inland lake could be established.

If we admit that the present submarine features of Bass Strait are not primary—that is to say that they were formed only towards the end of the period when Tasmania still formed part of the mainland, we must presume a period when they did not exist. As working backwards has not helped us very much, it will be better to start from a certain datum level, so to speak, and to work forwards. We will take the glacial period (1) in Tasmania as this datum level, irrespective for the moment of its correlation with European and American glacial stages.

6. THE PLEISTOCENE ICE AGE IN TASMANIA.

It would be out of place to go here into a detailed description of the features of the last glacial period in Tasmania. These have been sufficiently set forth by Montgomery, R. M. Johnston, and others. My investigations have shown that we can distinguish at least three centres of glaciation. It has not been quite proved whether these three centres existed all the time separately or whether they once merged into one sheet of ice. Further information is badly needed on this point. However, it does not matter much as far as the problem we are interested in, is concerned.

In the sketch map (Pl. II., Fig. 1) these three centres are named—

(1) The Cradle Mountain Centre.
(2) The Ben Lomond Centre.
(3) The Mount Wellington Centre.

(a) THE CRADLE MOUNTAIN CENTRE OF GLACIATION.

This area of glaciation includes all the highlands in the middle and north-west of the island, from the Great Lake on to Mount Lyell. The average present height of the plateau is about 2,000 feet. Though most, if not all, observations concerning the glacial period in

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(1) It must be kept in mind that in Tasmania there is evidence of at least two, if not three, glacial periods, separated by enormous intervals of time. The Permian and the Pleistocene period are undisputed, but since Howchin's epoch making discovery of a cambrian glacial period in South Australia, it has to be investigated whether certain conglomerates in Tasmania may not probably be due to the same cause.

Tasmania refer to this area, very little is still known about it; we even do not know its exact limits. It appears that in the west and north the terminal moraines reached down to a much lower level than in the west. Montgomery stated that on the Upper Pieman they descended to a level of 500 to 600 feet. On the Upper Forth I nowhere observed them to descend lower than 1,500 feet.

(b) THE BEN LOMOND CENTRE OF GLACIATION.

The extended plateau of Ben Lomond towers in the north-east corner of Tasmania up to a height of 5,000 feet. So far I have not visited it, but photographs exhibited by Colonel Legge show plainly moraines, roches, moutonnèes—in fact all the characteristic features of a surface formerly covered by ice. Mount Cameron, which I visited, shows the dome-like, roundish features which have been recognised as signs of a former glaciation.

(c) THE MOUNT WELLINGTON CENTRE OF GLACIATION.

Though almost at the gates of Hobart very little is known about this area. It extended probably towards west as far as Port Davey, where the dome-like figure of Mount Misery indicates glaciation.

Now, whichever view we take, it seems pretty certain that all that portion which is at present 2,000 feet and more above sea level was once glaciated, forming a nevèe. This probably sent out large glaciers, which descended if not into the sea probably close to the sea level. I estimate the area under glaciation at roughly 6,000 square miles—that is to say, one-quarter of the present Tasmania. This proves that the climatic conditions of Tasmania during the glacial period must have been considerably different from those of Tasmania of the present day. It is pretty certain to assume that the same conditions that produced the glaciation of the highlands of Tasmania prevailed also on the Antarctic continent; in other words, that the ice reached much further north than nowadays. The northern limit of the icebergs reaches in the meridian of Tasmania up to 50deg. lat.; that is to say, it is only 483 miles from the southern point of Tasmania (1). It is not too rash a conclusion to assume that during the glacial period the icebergs drifted some 7deg. further north, and probably stranded on the south coast of Tasmania. Considering all this, we can assume that Tasmania had during that time perhaps the climate of the Kerguelen islands; that is to say, a bleak, cold, and moist atmosphere, for the greater part of the year enveloped in a dense fog. There was no vegetation so to speak but moss and low shrubs. The button grass plains, as seen on the West Coast, and on the plateau near Barn Bluff, are perhaps the representatives of the flora that covered the lower elevations during the glacial period.

It is impossible to assume that human beings, even if equipped with all modern requirements, could exist under such climatic conditions, and we must therefore assume that the advent of man in Tasmania must have taken place after more congenial conditions had been established; that is to say, after the glacial period.

If we could correlate the last Tasmanian glacial period with any one of those recognised in Europe, we would have gained an important step. Unfortunately we have no certain data to go upon. All observers, in particular Montgomery, agree that the glaciation cannot be but of very recent date (2). It is probably not wrong to assume that the maximum of glaciation of the northern hemisphere coincided with that of the southern one, though one might perhaps argue that because the conditions of the southern hemisphere are the reverse of those of the northern, the glaciation of Tasmania coincided with an interglacial period of the northern hemisphere. I do not feel inclined to support such a view because it is more probable that those factors which produced the ice age acted simultaneously all over the earth and not alternately.

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(1) An 18-knot steamer sailing from Hobart would reach this line in about 24 hours.

(2) I can fully confirm this view. Near Barn Bluff the country looks as if the ice had melted away only yesterday.

I therefore assume that the last glacial period in Tasmania coincided with one of the stages of the last glacial period in Europe and America, and I presume that it corresponds to the Wurmian, if we presume that when the ice reached its last extension in Europe the causes were such that they also affected other countries producing glaciation. When there was one of the smaller stages in Europe, the causes producing glaciation were not strong enough to produce it somewhere else. I admit this is a theory pure and simple, but it is a workable theory. According to my view the charges resulting eventually in the formation of Bass Strait cannot have commenced earlier than after the Wurmian stage (1).

7. THE POST-GLACIAL RISE OF TASMANIA.

As far back as 1888 Johnston, and later on in 1893 Montgomery, were of the opinion that the present level of Tasmania is higher than it was during the glacial period. The logical sequence of this view is that during that time portions of Tasmania that are now dry were under water; in other words, the area of Tasmania during the glacial period must have been smaller than it is now. (See Pl. II., Fig. 1.)

Subsequently Gregory emphatically shares this view. A visit to Mount Lyell convinced him that during the glacial period Tasmania must have been several hundred feet lower than it is at present.

Independently of these authors, I arrived at the same conclusion when I ascended from the deep canon of the Forth to the plateau of Barn·Bluff. The difference in height between the River Forth and the end of the glacial valley on the plateau is 1,500 feet. The Forth is one of the rivers that discharge into Bass Strait, and it is obvious that its deeply cut canon can only have been formed during a time of rise aggregating to 1,500 feet at least.

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(1) The maximum glaciation in Europe took place during the Riss stage. If the glacial period in Tasmania corresponded to this stage, the subsequent elevation and the volcanic outbursts would correspond to the Wurm stage. This is a probability which has to be considered, particularly in face of the recent discovery of gigantic marsupials in Tasmania.

There is further evidence for a rise of the island all along its coast. These terraces can be seen near Strahan, the lower being about 50 to 60 feet, the higher about 1,300 feet above sea level. All along the north coast, in the neighbourhood of Hobart, in fact everywhere, terraces occur, indicating a rise. These terraces may have partly been formed during the melting of the ice; they may also have subsequently been deposited. They are therefore not pre-glacial, but either glacial or post-glacial. My observations in the valley of the Forth prove that during the glacial age Tasmania must have been about 1,500 feet lower than it is now (1).

This proves that Tasmania must have been much smaller than it is now, and I estimate that part which would be covered under water if the sea were to rise 1,200 feet above its present level to be about one-quarter of the total area. Tasmania would have therefore had an area of 18,000 square miles, one-third of which was under ice and snow. At the outside 12,000 square miles were free of ice, but it is probable that this land did not form a compact area, but rather narrow strips between ice and water, on which numerous icebergs floated. During the glacial period Tasmania must have therefore formed an island of about three-quarters of the present area, and there existed no land connection with Australia.

8. THE DURATION OF THE POST-GLACIAL RISE.

(PL. II., FIG. 1.)

I stated above that we are led to assume that the total rise can be estimated at 1,500 feet. Assuming the average height of the high terrace to be 1,200 feet—Gregory estimates it at 1,300 feet—we have to suppose that 300 feet more were laid dry. In other words, if we take present Tasmania and assume that the sea level were to recede 300 feet, we would have about the land as it appeared in post-glacial times.

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(1) If I understand Gregory correctly he estimates the rise to be 1,300 feet.

A receding of the sea level for 300 feet corresponds with the 50-fathom line. On the eastern coast of the isthmus the 50-fathom line is monotonous and not interrupted by any bays, but on the western coast we perceive a number of deep bays. The largest bay is found between 39deg. and 40deg. lat., and 143deg. to 144deg. long. A little further south there are three more bays, and further south still the 50-fathom line comes close on to the present coast line.

The whole appearance of the bays above-mentioned is such that they probably represent the mouth of old rivers coming from the north-east.

Now, let us assume that the sea level having receded to the 50-fathom line, and the basin of subsidence between Tasmania was not in existence. The south-east corner of Australia would then represent a large pointed peninsula, reaching almost to 44deg. lat. (1). It is obvious that under these circumstances the course of rivers from the north of Tasmania and from the southern coast of Victoria, in particular those east of Wilson's Promontory, must have been different from what it is to-day.

The rivers from Tasmania will have continued to run towards north, and those from Victoria towards south, till the two systems met, probably forming one large stream running in south-western direction across the peninsula. Traces of these old river courses are still preserved in the submarine contours of Bass Strait, the 40-fathom line showing them particularly well. The indented course in its eastern portion indicates the course of the old rivers, and the deep channel which runs in south-western direction represents most probably the course of this ancient river.

This hypothesis is strongly supported by another fact. Hitherto it has been rather a mystery to account for the strange similarity that exists between the fauna of the rivers in southern Victoria and northern Tasmania. Mr.

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(1) Australia would have a strange likeness to present Africa, during that time.

R. M. Johnston has kindly supplied the following information on this point:—

Four species of fish are identical, viz.:—

1. Gadopsis marmoratus (the well-known blackfish).
2. Galaxeus attenuatus (the jollytail).
3. Prototroches marena (the fresh water herring).
4. Retropora richardsoni (the fresh water whitebait).

Of molluscs there is

Unio mortonicus.

All these species originally occur only in the northern, but not in the southern rivers of Tasmania (1). The faunistic difference between the northern and southern rivers could not be sharper marked than by the distribution of the genus Unio.

The hypothesis here promulgated affords the easiest solution of the problem. If we assume that a large stream—the combined Mitchell and Snowy rivers—was running across the peninsula, successively taking up in its course the northern rivers of Tasmania, the road for a migration of the Victorian fauna into the northern rivers is open. Naturally the more mobile fishes found their way in larger numbers to Tasmania than the more slowly moving mollusca.

It will further be seen that on account of this fresh water fauna no saline lake, such as would result to-day if the sea level were to recede to the 45-fathom level, would have formerly existed. All lakes without discharge are saline, and the Bassian Lake would make no exception to this rule if it came into existence. Though therefore the Victorian rivers would discharge their water into this lake, its saline nature would certainly prevent the migration of the fresh water fauna from Victoria to Tasmania. It is, therefore, pretty certain that the depression in the centre of Bass Strait which would appear as a lake, if the sea receded to the 45-fathom level, was formed after the migration of the Victorian fauna into

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(1) Gadopsis marmoratus has now been imported into several southern rivers.

Tasmania. If we attempt to estimate the duration of the rise we may assume that the land rose say 3 feet for every 100 years, and the time required for a rise of 1,500 feet would be 50,000 years. We may therefore say that not less than 50,000 years ago a broad isthmus connected present Tasmania with Australia. This isthmus was traversed by a great stream coming from Victoria and discharging its water in south-westerly direction.

For the present it is impossible to say for how long this condition of things existed—in particular, how long the river system lasted. The gigantic marsupials which were believed to be restricted to the Australian continent have now—August, 1910—also been discovered in Tasmania. While cutting a trench in a marsh near Smithton, in north-west Tasmania, the remains of a large marsupial, probably Diprotodon, were unearthed. These giants had therefore already found their way to what is now the northern coast of Tasmania, but it seems pretty certain that they became extinct before they migrated further south. The problem is a very interesting one; so far none of their remains have been found in cave deposits or in the southern part of Tasmania. Is it probable that these gigantic marsupials represented animals that thrived only in a cold climate, and with the final disappearance of the glaciers they became extinct. Is it possible that the gigantic Diprotodon replaced in Australia the gigantic Elephas primigenius of Europe during the glacial period? This problem is of immense interest; but still much work has to be done before we can say anything definite. So far it is pretty certain that the gigantic marsupials can only have migrated to Tasmania when this country was connected with the mainland. This migration must have taken place either towards the end of the glacial period or immediately afterwards, but the animals died out before they had time to spread to the southern portion of Tasmania, and also that they had become extinct before the separation of Tasmania and Australia, viz., before the arrival of man in this island. We have no records that the Tasmanian Aborigines ever came in contact with these gigantic animals, and so far none of their bones have been discovered in the cave deposits near Rocky Cape.

The time when Tasmania was connected with the mainland by a broad isthmus, across which the Snowy-

Mitchell river flowed in western direction, was also the period of the gigantic marsupials. These became extinct before the arrival of man and the total separation of Tasmania, most probably either before or during the great volcanic eruptions that eventually led to the formation of Bass Strait. It is very probable that these giants were indicative of a cooler climate, but some further evidence is required before this question can be finally answered.

9. THE FORMATION OF BASS STRAIT.
(PL. II., FIG. 3.)

At the time when those tremendous disturbances set in that eventually resulted in the formation of Bass Strait, the following conditions must have prevailed.

The ice floes that covered a large part of Tasmania had disappeared, the land had risen—slowly perhaps, but probably rather rapidly—to such an extent that not only the present level had been reached, but that the sea level was 300 feet lower than it is at present. The energy of the erosion during this period of rise must have been very strong; the rivers had cut deep gorges into the country, and large quantities of debris were washed away by them, to be redeposited again in the shape of terraces along the rising coast. The present island of Tasmania formed the south-eastern corner of Australia, and the land that existed between it and present Victoria was traversed by a large river whose sources were in Victoria. The rivers coming from Northern Tasmania discharged their waters into this river, thus establishing a faunistic communication between Victoria and Northern Tasmania.

The climate may have been similar to the present one. It is more than probable that during this time the first animals migrated into Tasmania—a mixture of the present fauna and the gigantic marsupials of Australia. It is certain, as I will prove later on, that no human beings existed in this south-eastern corner of Australia during this period, which we must correlate to the post-Wurmian stage of Europe.

Before we follow up the different stages of the changes that now set in, we will endeavour to calculate the time that would be required to change the above features into those of the present day. A rise of the sea level of 300 feet would be sufficient, and assuming the rate to be 3 feet per century, altogether 10,000 years would be required. According to my estimate 60,000 years would have lapsed since the end of the glacial (Wurmian) period. This figure agrees remarkably well with those obtained elsewhere. It is estimated that 56,000 years lapsed since the end of the glacial period in America. The German geologist Penk estimates that 50,000 years rather than less have lapsed in Europe; others, like Hildebrand, estimate the time to be 30,000 years. However, it seems to be pretty certain that not less than 24,000 years, but probably not more than 60,000 years, have lapsed since the end of the last glacial period.

The last 10,000 years of this period witnessed tremendous changes in Tasmania—those changes which are responsible for our present-day features. They must have commenced with a subsidence of the surface between 39deg. and 41deg. southern lat. and 145deg. and 146deg. long. It is not only probable, but pretty certain that this catastrophe was accompanied by earthquakes and volcanic eruptions. All along the northern coast of Tasmania we find the remains of lava streams. Though some of them seem due to local eruptions, others cannot have possibly come from the south—i.e., Tasmania; their origin must be in the north, where Bass Strait is now. For instance, the cap of basalt on Freestone Bluff, near Wynyard, must be considered as a rest of such a stream.

We have another remarkable proof that the first area of subsidence as represented by the 45-fathom line must be connected with volcanic eruptions. We see that all the younger volcanic rocks of the Midlands and Southern Tasmania are situated on a line which forms the southern continuation of the main axis of the trough formed by the 45-fathom line. (See Pl. II., Fig. 3.) It is perhaps probable that a fissure resulting from the squeezing up of Tasmania gave first rise to these volcanic outbursts.

The lava streams of the great volcano in Bass Strait which flowed towards south blocked the course of the rivers flowing north, the water was dammed up and behind the walls of lava, those fresh water lakes were formed whose deposits we now find everywhere in Northern Tasmania.

It is difficult to say how long this period of volcanic activity has lasted. It is possible that everything was over with one great eruption; but it also seems as if there have been several successive eruptions. We have seen above that the greatest changes took place between the 35 and 45-fathom line. If we assume that the greatest volcanic activity was finished at the period represented by the 35-fathom line, the volcanic period would have lasted about 3,000 years.

It is pretty certain that during the volcanic period, and probably also for some time afterwards, the subsidence of the surface continued; it is, however, also certain that when the sea had reached the 35-fathom level the subsided area was filled with water. The craters (1), consisting mostly of ashes and loose material, were washed away, and a great bay or almost inland sea was formed, which communicated in the west by a narrow strait with the open ocean. The road for the migration of the Adelaidean fauna was open, but it could not move beyond 147deg. long., because an isthmus still intervened here.

A further rise of the sea level for 30 feet, corresponding to a period of 1,000 years, considerably reduced the width of the eastern land bridge, and we see that now only a very narrow isthmus connects Tasmania with Australia.

Another rise of 30 feet, corresponding to a period of 1,000 years, is sufficient to separate Tasmania permanently from the mainland.

The further changes do not interest us much, except that the last period, including the stages from the 25-fathom line to the present level must have lasted 5,000 years if the sea rose at the rate of 3 feet per 100 years.

The comparatively short period of 5,000 years fully explains why the Adelaidean and Peronian faunas are still so sharply divided. The time since the opening of the eastern strait has been too short to allow for a mixing of these two faunas, even if we assume that the Adelaidean fauna migrated into the inland sea the moment communication with the western ocean was opened.

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(1) It is very probable that a considerable quantity of the material which formed the craters was redeposited by the water, thus levelling up again the depressions.

I need hardly to mention that the above figures are based on averages, and though the aggregate may be fairly correct the components may be quite erroneous. For instance, if we take the time since the commencement of the volcanic activity till the time when Tasmania became separated from the mainland to be 5,000 years, we may assume that the whole of the volcanic activity was over in, say, 1,000 years, while the balance of 4,000 years represented a period of quietness, or better, slow changes. It may also be that the second period of 5,000 years which have lapsed since the separation is in fact much shorter, owing to the sea rising quicker during this than during the earlier period. It is, of course, impossible to go into such questions, which are but vague speculations. We are bound to go by average figures, on which a working theory can be based, but we must not be led astray by factors which may be probable but which cannot be proved.

10. THE TIME OF THE IMMIGRATION OF THE ABORIGINES INTO TASMANIA.

The above arguments give us the key to the solution of the problem when the Tasmanian race first arrived on the island. Three facts are absolutely certain, viz.:—

(a) The immigration must have taken place while Tasmania was still connected with the mainland of Australia.

(b) The immigration must have taken place after the disappearance of the gigantic marsupials.

(c) The immigration must have taken place before the appearance of the dingo in Victoria.

The immigration must therefore have taken place in post-glacial time; the period that lapsed since the glacial time has been estimated at 60,000 years, which can be divided into two very unequal stages, the earlier lasting 50,000, the later 10,000 years. At the beginning of the later period great tectonic and volcanic changes took place on that portion of the earth which is now occupied by Bass Strait. Had the immigration taken place previous to the volcanic period, we must expect to find remains of the race, such as their archaeolithic implements, in beds overlaid by the basalts and lava streams. No such traces have ever been found, though the tin-bearing drifts, which are overlaid by volcanic rocks, have been extensively worked. We must assume that the immigration took place after the young volcanic period. This view fully harmonises with that of Gregory, who conclusively proved that the immigration of the human race in Victoria must have taken place after the young volcanic period. Man, therefore, did not witness those enormous volcanic outbursts which are chiefly responsible for the production of the present outlines of Southern Victoria and Northern Tasmania; he arrived after everything had quieted down. I have above pointed out that the end of the volcanic period most probably coincided with the 30-fathom line. During this period Tasmania was still connected by a narrow isthmus with the mainland, but a rise of five more fathoms is sufficient to separate it permanently.

The immigration of the Aborigines must therefore have taken place after the young volcanic period, but before that period which is represented by the 25-fathom line. According to my calculations the immigration cannot have commenced earlier than 7,000 years ago, and it must have been finished 5,000 years ago. In other words, the Aborigines cannot have arrived in Tasmania earlier than 5,000 B.C., and not later than 3,000 B.C.

The total number of years the Tasmanian race inhabited this island can therefore be estimated at from 5,000 to 7,000 years.

This may perhaps be a somewhat startling view, contrary to time-honoured notions (1), but if we want proofs for a great antiquity not one is forthcoming. On the other hand, my view is fully borne out by the investigation of the camping grounds. I, as well as numerous others, have noticed that the tronattas are restricted to the surface; none are in the subsoil, however much I searched for them. The number of specimens on the surface is never very large (2), and this proves that the camping-grounds could not have been used for any length of time. In fact, the whole appearance of the camping-grounds proves them to be of quite a modern date; not a single one has been found which could claim any antiquity.

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(1) One of the most favourite arguments in favour of a great antiquity of the human race in Tasmania are the enormous shell heaps. According to the prevailing views these shell heaps can only have been formed in the course of a very long period. Nobody has, however, taken the trouble to ascertain whether

Even if my figures are not accepted, there remains at least one unshakeable fact—the immigration of man into Tasmania must have taken place in a geologically very recent period, viz., after the young volcanic period, but it must have taken place before the appearance of

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this view is borne out by the facts. A short calculation will show us that enormous shell heaps must collect in comparatively short time.

According to the best authenticated figures the total population of Tasmania was 2,000 souls in 1803. Now, let us assume that each individual consumed 50 oysters, including mutton fish, mussels, etc., per day—surely not too great an allowance. Therefore, 100,000 shell fish of sorts were consumed per day, or three million per month, equal in round figures to 36 millions per year.

According to my estimate of time 180,000 million shell fish would have been consumed in 5,000 years, and 254,000 million in 7,000 years Assuming that the valves did not weigh more than two ounces, the weight of these shells would be 13.2 million tons and 18.8 million tons respectively.

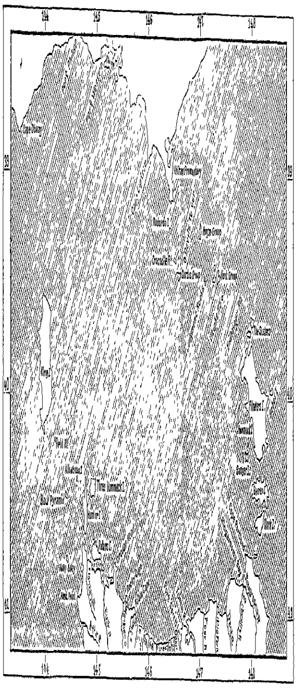
Now, let us assume that in the average each oyster or haliotis shell measures 4 x 3 x 1 inch—a very moderate estimate of size; therefore 144, say 150 shells, would go to the cubic foot, and the above numbers would be equal to 1,200 million and 1,693 million cubic feet respectively, which would cover a tract of land measuring half-a-mile in width and 10 feet deep for 10 or 16 miles in length, according to the lower or higher figure.

These figures prove conclusively what enormous shell heaps gather in such a short time as 5,000 or 7,000 years. If Tasmania had been inhabited for any longer period, say 50,000 or 100,000 years, the shell heaps would be much more extensive than they actually are. According to the above calculations, 12,000 million cubic feet of shells, weighing 92.4 million tons, and covering a strip of land half-a-mile in width and 10 feet deep for 20 miles in length, would have been left behind, an area which would increase to 40 miles in length were the time to be 100,000 years.

From what I have seen of the shell heaps their total bulk would not come anywhere near 1,200 or 1,700 million cubic feet, much less to 12,000 or 24,000 million cubic feet. The shell heaps, large as they appear, are therefore rather a proof in favour of a small than of a great antiquity of man in Tasmania.

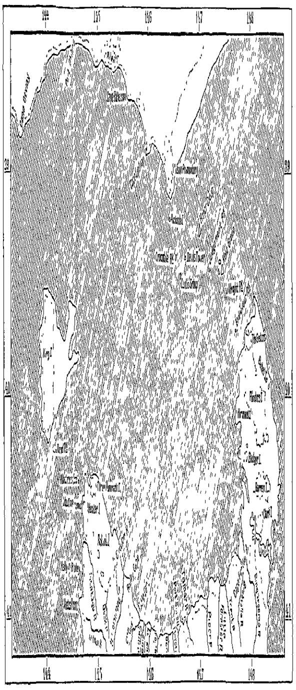
(2) Except, of course, in the quarries.

Fig. 1.



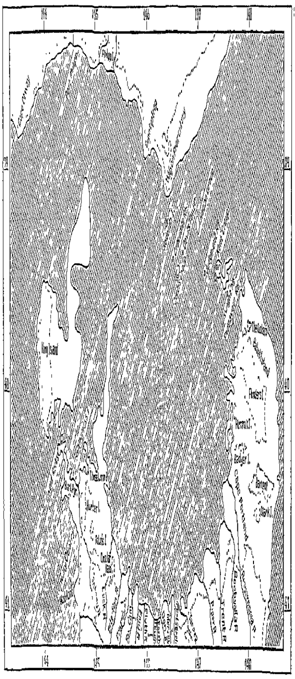
Present Sea-level.

Fig. 2.



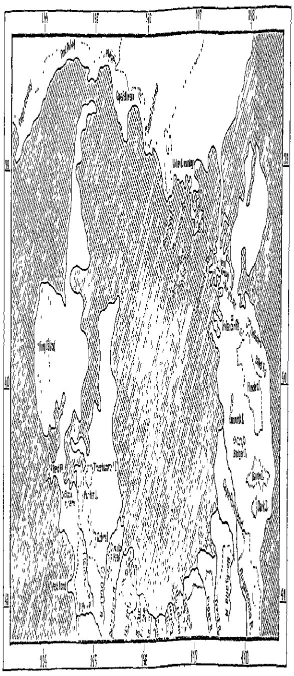
20-fathom line.

Fig. 3.



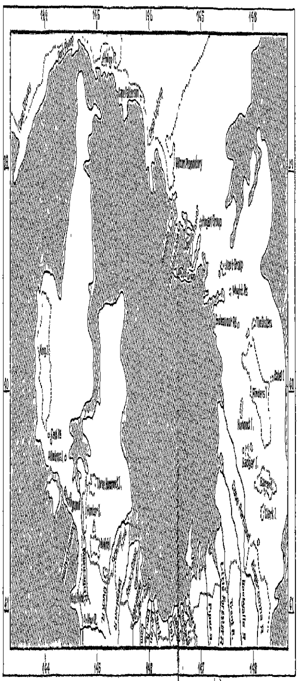
25-fathom line.

Fig. 4.



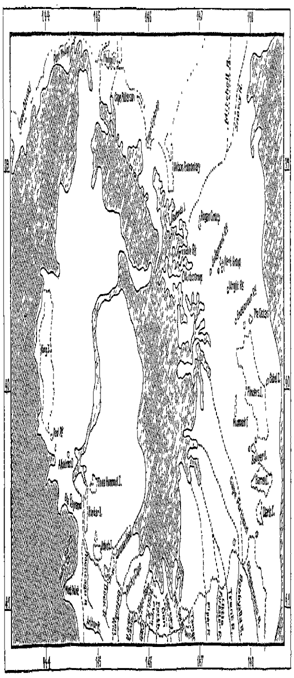
30-fathom line.

Fig. 5.



35-fathom line.

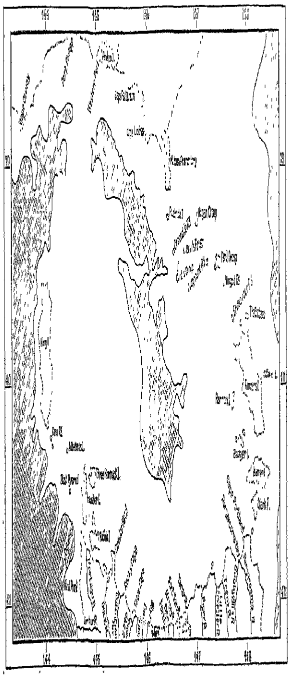
Fig. 6.



40-fathom line.

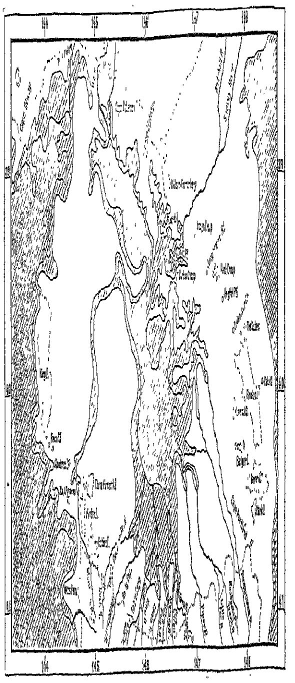
(F. NOETLING.)

Fig. 7.



45-fathom line.

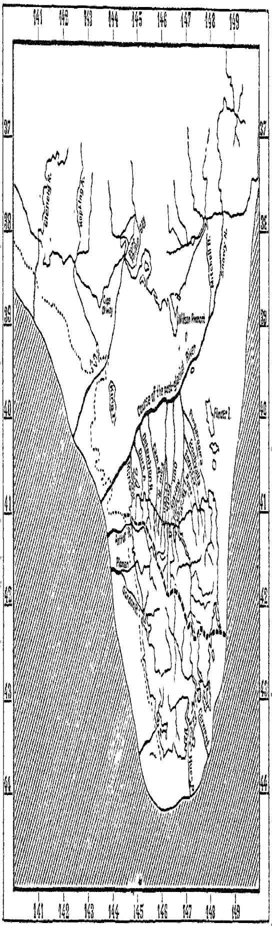
Fig. 8.



50- and 55-fathom line (hypothetical inland lake).

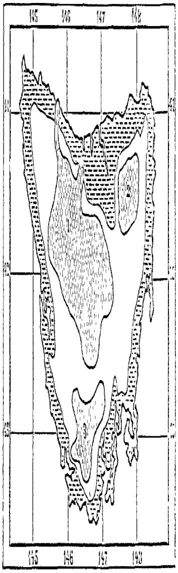
THE SUBMARINE PHYSIOGRAPHY OF BASS STRAITS.

Fig. 2



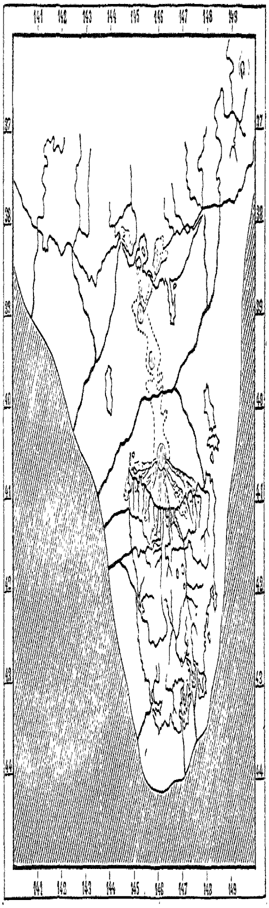
The Post Glacial River System of South-East Australia.

Fig. 1.



Glaciation of Tasmania.

Fig. 3



The Post Glacial Volcanoes of the Bassian Isthmus.

the dingo in Victoria. All those who have earnestly studied the subject, like Howitt, Gregory, Etheridge, and myself, come to the conclusion that the arrival of man in Australia must be of very recent age. We all agree that it must come, as far as Tasmania is concerned, between the above two limits, which in my opinion are represented in absolute time by 5,000 B.C. and 3,000 B.C., and that it was finished when the dingo appeared in Southern Victoria.

The foregoing features are summarised in the following table:—

STAGES.	GEOLOGICAL EVENTS.		SEDIMENTS AND ROCKS.	FAUNA.
Present Times.		Complete separation of Tasmania and Australia	Modern Silts and Sands. Formation of Shell Heaps.	The European Race occupies Tasmania.
Pre-Historic Times.		Formation of Bass Strait finished (about 5000 years ago)		Immigration of Canis Dingo in Australia.
		Submergence of Bassian Isthmus continues (about 7000 years ago)		Immigration of the Tasmanian Aborigines 5000–3000 B.C.
Post Glacial Stage.	Younger Volcanic Epoch	Gradual destruction of Bassian Isthmus Submergence of Land (about 10 000 years ago)	Basalts of Table Cape. One Tree Point, Geilston, etc.	Fauna not known yet.
	Bassian Isthmus Epoch	Gradual rise of land a broad isthmus connects Tas. and Aust. The combined rivers of S. Vic. and N Tas. form large stream which flows in a western direction across the isthmus (about 50,000 years ago).	Formation of Gravel Terraces. Wynyard Beds (?).	Gigantic Marsupialia disappear. Diprotodon Fauna.
Last Glaciation Wuerm Stage.		Glaciation of Tasmania (about 60,000 years ago)	Moraines in different parts of Tasmania.	Fauna unknown, but most probably of Arctic character.

ON CERTAIN TYPES OF STONES USED BY THE ABORIGINES.

By H. Stuart Dove, F.L.S.

(Read April 11th, 1910.)

There are in North-west Tasmania two distinct types of the Aboriginal relics, usually called Hammer or Pounding Stones, but regarded by Dr. Fritz Noetling as "sacred" or "magic" emblems. The photographs of several in Dr. Noetling's collection appeared in an early issue of the "Tasmanian Naturalist," also in the "Weekly Courier," Launceston, of September 19th, 1907.

The stones of type 1 are thick and heavy, usually convex on both surfaces. Those of type 2 are thinner and lighter, usually flat on both surfaces. If any convexity exists it is very slight. Both kinds are more or less circular in outline, but very frequently are longer in one diameter than the other, and the thickness often varies when taken at different portions of the circumference. The largest example in my possession of the first type measures 5½in. x 4½in. x 1¾in. in thickness, and weighs 3lbs. avoirdupois. One in possession of a friend is much larger, weighing 5¼lbs.; another turns the scale at 4¼lbs., a third at 3¼lbs. It is somewhat curious, as they all come from the same district, that there should be this regular gradation of 1lb. in weight. The 3lbs. example just alluded to has been slightly treated on each of the longer sides by chipping or hammering, and the centre of both upper and lower surfaces bears marks of repeated hard blows, causing a rough hollow of an inch or rather more across, but not more probably than 1-16in. in depth, although the dints are very perceptible to the touch, and can be distinctly seen without a lens.

The smallest example I have of this type measures 4¼in. x 4⅛in. x 1¾in. in thickness, and weighs just under 2lbs. About half the circumference appears to have been chipped or hammered, and then rubbed smooth; part of the remaining circumference has been roughly chipped and left without any smoothing process, while the remainder is in its natural state.

I will state here that the type just described is not necessarily of greater diameter than those about to be touched on; indeed, the smallest of type 1 are much less than the largest of type 2; but in those of similar diameter the greater weight is always with the first group.

The largest of the second or flat type measures 5in. x 5in. x 1⅛in. in thickness, and weighs 2lbs. 3oz.; the edge has been much worked by chipping or hammering, and the stone is almost a perfect circle. The object of the natives in working at the edges of these stones appears to have been to get them as circular in outline as possible, although whether this was done to please the eye or with some ulterior purpose we have no means of knowing. All the circumference except about 1¾in. has been worked in this case, and the centres of both surfaces bear marks of having been hammered upon.

The smallest I have of this flat type is a very nice light specimen of an ounce or so under 1lb., measuring 4¼in. x 3¾in. x ¾in. in thickness, though the latter dimension varies slightly, in one part being ⅝in.; the circumference has been treated all round except for about ¾in.; one surface is very slightly convex, and in this small dints caused by hammering can be felt with the finger-tips; the other surface is smooth.

While searching the site of an Aboriginal camp I noticed the edge of a stone projecting above the surface of the ground in an oblique direction. On raising this carefully it proved to be one of the flat type, measuring 4¾in. x 4in. x 1⅛in. in thickness, and weighing 1lb. 10oz. Although the circumference had been worked upon considerably for three-quarters or so of its entirety, the specimen had not been made very circular, as will be noticed by the measurements. There were slight marks of hammering in the centres of both surfaces; but what rendered this specimen peculiarly interesting was the fact of it throwing light upon the use to which some at least of this class of stone was put. In the centre of one surface can still be seen some of the red ochre which was pounded upon the flat surface of the stone, and which has been preserved from erosion by being buried underground. As many lumps of ochreous earth are found at the old camps, and as it is known from records that our natives made use of this as a pigment when pounded and mixed with grease, it is evident that some of these flat stones were used for breaking down the lumps upon, which accounts for the dints in their centres. The other specimens that I have were all found upon the surface, and having been exposed for so many years to the action of wind and rain, it is not at all remarkable that no traces of colour should be found upon them.

The strangest looking specimen is one that was obtained from the neighbourhood of the Upper Mersey, and appears to be the half of an irregular oval stone which has been fractured; the piece measures 4¼in. x 3¾in., and varies in thickness from 1½in. at one edge to ¾in. at another. It weighs 1lb. 11oz. A portion has been split off from each side, but not from the end, so that the semi-circular part of the circumference which remains projects each side in an ear or "lug," giving the stone a very fantastic appearance. This "lug" projects about ⅜in. on one side, and rather over ½in. on the other. The circumference which remains has been worked by chipping or hammering.

Besides these I have the segment of an exceptionally large and heavy stone of the flat type; this portion measures about 5½in. across at circumference, and tapers to a blunt end; the thickness varies from 1⅜in. to 1in., and the weight is 3lbs. 1oz., so the original must have been of a great size. The edges have been worked as usual, but in addition they appear to have been subjected to some kind of smoothing process, as if rubbed with water on another stone. The flat surfaces, too, have smooth streaks across, as if produced by rubbing upon another surface. This appearance may, however, have been caused by the friction of the loose dry sand upon which the fragment was found.

The material of all specimens of both types appears to be diabasic, which is so frequent on this coast. The usual colour is a light grey flecked with numerous small dark fragments, the fresh fracture showing a bluish tint.

COMPARISON OF THE TASMANIAN TRONATTA WITH THE ARCHAEOLITHIC IMPLEMENTS OF EUROPE. (PL. III., IV., V. AND VI.)

By Fritz Noetling, M.A., Ph.D., etc.

(Read 13th June, 1910.)

1. THE CHIEF FEATURES OF TASMANIAN CIVILISATION.

Before we compare the Tasmanian tronatta with the similar implements from Europe, it will be useful to fix the main features of the Tasmanian civilisation, because it represents the purest type of archaeolithic civilisation. We may deplore the fact that the Tasmanians died out within a few years since they came in contact with the Europeans; yet even this had its advantages. There was no time for the inception of ideas foreign to the Tasmanian mind; the primitive state of civilisation could not be adulterated by other notions. This preservation of the archaeolithic stage in all its pureness would have been impossible if the Tasmanians had become more or less acquainted with foreign ideas. We would always have to consider the probable influence of extraneous notions had this been the case. However unfortunate this may have been for the Aborigines, the student of the evolution of mankind must consider it as a very lucky incident. We know absolutely nothing about the human beings that used the archaeolithic implements in Europe; but if we apply the method so successfully used in palaeontology to our case, we must consider the Tasmanians as the living (1) objects the study of whose habits and customs gives us the key to the understanding of the state of civilisation of the fossil races—our own ancestors in all probability.

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(1) Of course the Tasmanian race is extinct now, but it died out within the memory of many still living, and as we are well informed about many of their customs we can consider them the "living objects" with which we can compare the relics of quarternary and tertiary races.

The Aborigines had already made at least one important invention, based on a certain amount of logical reasoning. Instead of using any pebble or rock in its natural state, they had learned that certain siliceous rocks could be split, and that the flakes, by means of their sharp edges, were more suitable implements than those provided by nature—for instance, sharp-edged pieces of columnar diabas. The latter were, of course, still resorted to, but the bulk of the implements were artificially manufactured by the breakage of suitable siliceous rocks. It is one of the peculiarities of these siliceous rocks that they have a conchoidal fracture, which renders the production of sharp-edged flakes comparatively easy. And it is another peculiarity than when a flake is detached from a parent block, that face by which it is detached is generally very smooth and level. The flake breaks off in a plane, which may be more or less convex, but it always forms one plane. The shape of the face opposite the flat one is determined either by the original surface of the parent block or by the size and number of flakes previously struck off.

This peculiarity of fracture is probably the cause of the particular way these flakes were grasped. The thumb invariably rested on the flat side, not in the reverse way, be it well understood. This practice being in use for generations, eventually became an inborn habit. The foremost thought of the Aborigines when manufacturing an implement was the production of a plane face as rest for the thumb; the shape of the other face was immaterial. It may have been made more convenient to fit the hand by striking off smaller flakes, or it may have been left as it originally was, but its shape was of no importance.

The chief feature of the Tasmanian stone implement is its unsymmetrical shape. Even if—as it has been noticed in some specimens—there is an attempt of a symmetrical outline, the symmetry of the two faces is still existent. It is therefore obvious that the Tasmanian tronatta could not be altered without destroying its essential features. The indical face could be treated by the most delicate or regular chipping; the outline of the tronatta may have been so carefully shaped that it was perfectly symmetrical in two directions; all this did not alter the character of the tronatta, which still retained its essential feature, viz., a smooth pollical face, in opposition to a more or less convex, wrought, indical face.

It will therefore be seen that the tronatta is incapable of further development without losing its character. I do not want to be misunderstood; I do not wish to say that the tronatta is not capable of further development; it is rather the opposite way; but any such development destroys its character as a tronatta. Neolithic, or even palaeolithic, implements can be materially altered and improved without losing their distinctive features, but not a tronatta.

We see, therefore, that that stage in the evolution of stone implements which is represented by the Tasmanian tronatta does not allow for improvement of its implements. The only direction in which an improvement can be carried out is in the more careful treatment of the indical face, and as far as I can see the Tasmanian Aborigines had reached that highest stage of perfection. But simultaneously with such highly-finished implements there were others in use that showed little or no improvement at all. This would tend to prove that it is impossible to classify the archaeolithic stage according to the finish of the implements; on the other hand, it seems that in the earlier periods the implements showed on the whole a much rougher finish than those represented by the Tasmanian tronatta.

The most remarkable feature in connection with these implements is the fact that though the Tasmanians had a rudimentary knowledge of the art of grinding, they never used it to improve the efficiency of the tronatta. They had not made that invention yet, and they probably never applied it in the manufacture of tronattas, because their essential features would have been destroyed thereby.

The tronattas were tools only, and they were never used as weapons. The Tasmanian civilisation had not made the invention to provide the spears with stone heads or to fix a handle to some of the large tronattas. Their chief weapon was a wooden spear of considerable length, but rather light; besides the spear they used a short throwing stick pointed at both ends. Their utensils were of the most primitive type, and consisted mainly of neatly plaited baskets and a sort of pitcher made of seaweed. Clothing was practically unknown to them, which is somewhat remarkable considering that in winter time all heights above 1,800 feet are snow-clad for several months, and that the temperature even at sea level is pretty cold.

Their ornaments consisted in a shell necklace for the women, while the men rubbed a mixture of red ochre and grease into their hair. Their encampments were mainly situated on warm, sandy soil close to fresh water, but they apparently never constructed any huts, except a rough sort of shelter or breakwind of bark. Occasionally they may have resorted to caves, but to judge from the great scarcity of implements in the cave deposits, these caves were no dwelling places, but rather places where they consumed their meals only.

Their food (1) consisted of the natural products of land and sea, but they had no idea of agriculture, nor did they ever make an attempt to domesticate the animals running wild in Tasmania (2).

They had learnt to make a fire, though there is some doubt as to how it was made. There is a great probability that they used siliceous stones for striking fire, though it is probable that they produced it by the fire stick and drill.

The dead bodies were disposed of by burning, and subsequent burial of the ashes.

If they had any religious notions they were of the crudest form, and mainly restricted to certain rites, in which flat, curiously marked pebbles, representing dead relatives, played a great role.

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(1) See also "The Food of the Tasmanian Aborigines," Pap. and Proceed. Roy. Soc. Tas., 1910.

(2) It is a remarkable fact that the Tasmanians soon recognised the value of dogs for their hunting expeditions. Under these circumstances it is very strange that they never made an attempt to domesticate the Tasmanian tiger or the devil, both animals that would have been very suitable for hunting.

2. CONCLUSIONS AS TO THE STATE OF PRIMITIVE MAN IN EUROPE.

Now, what inference can be drawn from these facts with regard to the European races that used implements of exactly the same type as the Tasmanian tronatta?

We can in the first instance state with almost certainty that none of these implements were weapons. They were used as tools only, and for no other purpose. Archaeolithic man of Europe had neither bow and arrow, nor were his spears provided with a stone head. It is therefore absolutely futile—in fact contrary to all knowledge—to discern arrow, spear, and axe heads among the archaeolithic implements of Europe.

The only weapon of archaeolithic man was a wooden spear, probably rather long long and light. Possibly he may also have had short throwing sticks; but he certainly did not use clubs (1).

There is a great probability that he smeared his hair with a mixture of red ochre, and that he had already learnt the art of plaiting baskets, and had a rudimentary knowledge of the art of grinding. His encampments were close to the rivers, probably on open, sandy soil. He had no domesticated animals, neither did he cultivate the soil; he had learnt to produce fire, and he burnt in all probability the dead. Religious notions were of the crudest form, and probably restricted to certain ceremonies in which round flat pebbles played a great role.

In one point only archaeolithic man seems to differ from the Tasmanians. The Aborigines were practically naked; now and then they seem to have worn a skin loosely slung round the body, but there was no attempt of a habitual covering of the body even in the coldest weather. It is perhaps probable that the oligocene or miocene human beings were in a similar state of nakedness, but it is impossible to assume that those that existed during the glacial period did not cover their bodies, unless we believe that the body was still covered with a thick fur.

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(1) Another notable fact must strike the observer: The first weapons primitive man manufactured were meant to be used at a long range. It is only later, when sword and axe had been invented, that the combatants came to close quarters. Modern man has again reverted to the practice of primitive man, to fight its battles at long ranges, only that the range is now almost as many miles as it used to be feet with primitive man.

Archaeolithic man had not made those simple inventions that were to raise him from the state of savageness to a higher level. All these inventions, the use of stone as weapons, the hafting of weapons and tools, must have been made early in the palaeolithic age, and it is very probable that the first invention made was the providing of the weapon of age—the wooden spear—with a stone head instead of sharpening its point. The natives of the Admiralty Islands have typical archaeolithic stone-heads glued to their lances; the Queensland Aborigines use still the unsymmetrical archaeolithe as a spear-head or a dagger, either with or without a handle, though a tendency to give the archaeolithe an intentional shape is apparent. In Western Australia the Aborigines use beautifully-finished spear-heads of palaeolithic type, but other weapons are unknown to them.

On the whole it appears that the substitution of the wooden point of the spear by a stone head was the first great invention that man made after he had for countless generations used a sharply-pointed piece of wood as spear.

It is therefore obvious that if such was the state of civilisation of archaeolithic man in Europe, nothing but the indestructible stone implements used by him was left behind. In fact, there is very little chance of discovering its bones, except in such cases when a lucky accident, such as a slip of rock or earth, prevented the corpse to be disposed of in the usual way. Otherwise the dead bodies were burnt, and the few fragments that remained of the larger bones soon crumbled to dust.

Considering that archaeolithic man burnt his dead, I have my gravest doubts whether the corpse of Homo Aurignacenis was really buried. The accounts of the discovery of the skeleton make another theory quite permissible. It may be possible that the skeleton belonged to a man, perhaps a kind of chief, who was lying sick in the cave; in order to make him more comfortable, a sort of hollow was scratched out in the ground, in which he rested in a half-sitting position. While his friends were away a portion of the roof fell in, and killed him. The debris completely hid the body, thus preserving him for future generations. When his friends returned and found a heap of loose blocks instead of a live being they probably fled in superstitious terror. If the Aurignac race buried their dead, why have not any more skeletons been found? Even the Tasmanians had special burial grounds for the ashes away from the camping grounds, and it is, in my opinion, not very probable that the higher Aurignac race buried their corpses in their living grounds (caves). If the Aurignac race did bury their dead it would be more probable to assume that they had special burial grounds. On the whole, I think that all the circumstances point more towards an accident than towards an intentional burial. The discovery of the skeleton does certainly not prove that the Aurignac race was in the habit of burying their dead.

3. COMPARISON OF THE TRONATTA WITH THE ARCHAEOLITHIC IMPLEMENTS OF EUROPE (1).

The greatest authority on eolithic and archaeolithic implements, Dr. Rutot, has by his strenuous work fully cleared up the geological sequence of the different industries distinguished by him and others in Europe. In the following table I give his classification in a somewhat modified form, but it must be understood that the sequence of the different industries has not been altered.

We see from this table (pag. 9) that we know now two tertiary, one præ-glacial, and twelve glacial industries. Of these 15 industries only seven can be considered representing the archaeolithic stage, viz., the two tertiary, the two pliocene, and the three lower quarternary industries. Thanks to the generosity of Dr. Rutot and Professor Dr.

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(1) See also Rutot. Un grave probleme, Bull. Soc. Belge de Geol. Pal. Hyd., vol. xxi., 1907.

Verworn, I have a very instructive collection of specimens from the following industries:—

Upper Palaeolithic Stage.	9.	Solutreen	Upper Quarternary	
Lower Palaeolithic Stage.	8.	Mousterien	Middle Quarternary	Glacial Period
	7.	Acheuleen		
	6.	Chelleen		
Archaeolithic Stage.	5.	Mesvinien	Lower Quarternary	
	4.	Mafflien		
	3.	Reutelien		
	2.	Cantalien	Tertiary	
	1.	Fagnien		

As the Tasmanian tronatta represents the purest archaeolithic stage, we see that only the last five industries would come in for comparison. But the archaeolithic implement had a tough life; it was never quite discarded. We find archaeolithes among all the palaeolithic industries; in the Flenusien, as Dr. Rutot has shown, neolithic implements of the highest type were used simultaneously with archaeolithes of the crudest form. The use of the archaeolithe continued even to the metalliferous period. In Baluchistan I found archaeolithic knives side by side with well-finished arrow heads and celts of palaeolithic type, and a fine celt probably of copper. There can be no doubt that the archaeolithic implement is much quicker produced than a palaeolithic or a neolithic one. From this point of view it is quite intelligible why archaeolithic implements were still in use even when the stone industry had reached its highest perfection, and even in the earlier days of the metalliferous age. As already pointed out, the archaeolithic implement could not be perfected without losing its character, and we see, therefore, that the youngest archaeolithe is undistinguishable in form from the oldest one.

The oldest human industry was discovered by Dr. Rutot at Boncelles, in Belgium. The specimens he sent me from this locality are of a very crude type; yet it would be possible to find a match for each of them among the more primitive tronattas. A large number still retain the original crust, and it appears that in many cases a natural fragment was used without being previously split off a parent block. Others are, without doubt, flakes that were detached from a larger block, and a fine bulb of percus-

		GEOLOGICAL STAGES.	SUB-INDUSTRIAL STAGES.		INDUST. STAGES		TASMANIA.
QUARTERNARY.	Upper	Post-Glacial Period		Magdalenien	Upper	PALAEOLITHIC STAGE	Separation of Tasmania from the Mainland Immigration of Aborigines Epoch of Gigantic Marsupials
				Solutreen			
			Aurignacien	Upper			
				Middle			
	Middle	4th Glacial Period (Wurmian)		Lower			Glaciation of Tasmania
		Last Inter-Glacial Period	Mousterien	Upper			
				Middle			
				Lower			
				Acheuleen II.	Lower		
		3rd Glacial Period (Rissian)		Acheuleen I.			
		Middle Inter-Glacial Period		Chelleen			
				Strepyien			
	Lower			Mesvinien		ARCHAEOLITHIC STAGE	
		2nd Glacial Period (Mindelian)		Maffiien			
				Reutelien			
TERTIARY.	Pliocene	1st Inter-Glacial Period		Saint-Prestien			
		1st Glacial Period (Gunzian)		Kentien			
	Miocene	Upper Middle Lower		Cantalien			
	Oligocene	Upper Middle Lower		Fagnien			

sion can be seen on several specimens. One specimen which has been determined by Dr. Rutot, "Percuteur tranchant," shows a fine smooth pollical face, and on the indical face the traces of misspent blows can be seen, exactly as they can be observed on numerous specimens from Tasmania.

The same remarks apply to the specimens from the Cantalien. In the collection from Puy de Boudieu the specimens attain considerable size and weight, though it is certain that, exactly as in the case of the tronatta, the implements of 4 ounces and under form far the majority. On the whole these specimens do not show a very careful treatment of the indical face. I am unable to give an explanation for this except the nature of the flint. The specimens from Puy de Boudieu were manufactured from rather thin, flattish pieces of flint, which by their nature had a pollical face, and, being comparatively thin, not much trimming of the indical face was required. A few specimens, and apparently mostly those that represent flakes detached from a larger piece, show a fair amount of trimming of the indical face.

If we now leave the tertiary and turn to the industries of the glacial period and those that immediately preceded it, I am unable to offer an opinion about the implements of the Kentien and Saint Prestien industries. To judge from the figures it appears, however, that River-drift implements already represent a much higher than the archaeolithic stage. The few archaeolithic implements found in England are probably of that kind that was used simultaneously with implements of a higher stage, and it almost appears that a true archaeolithic industry did not exist in Great Britain.

The oldest of the industries of the glacial period is the Reutelien, of Belgium. The implements of this industry are as crude as those of the earlier tertiary industries; there are, however, several specimens from Elouges showing a considerable amount of treatment of the indical face. Among the specimens belonging to this industry which Dr. Rutot kindly sent me are a number of rough and insignificant-looking pieces from Leval. I had not the slightest doubt that numerous scientists were not inclined to consider these specimens as treated by human beings; yet I could place side by side to every one of them, a specimen from Tasmania. Though very insignificant looking, these specimens have been submitted to a good deal of hammering, but whether we consider them as actively or passively used matters very little. The main point is that they were used by human beings.

I have only a few specimens from the Maffiien industry, but a larger one from the Mesvinien, from the famous locality of Spiennes. The implements of that industry find their counterparts in the tronatta, though it seems that on the whole the treatment of the indical face never attained the high finish of some of the tronattas. The most interesting specimen is a rolled pebble of flint, probably a reject, which proves conclusively that the Messinien industry obtained some of the material from gravel deposits, exactly as the Tasmanian industry did. This ends the archaeolithic, or as Dr. Rutot says, the eolithic stage of the evolution of stone implements. The next stage, the Strepyien, is considered by Dr. Rutot as a passage stage between the archaeolithic and palaeolithic periods. It must, therefore, be of a particular interest, because its implements should exhibit the evolution of the unsymmetrical archaeolithic into the symmetrical palaeolithic. In the next higher stage, the Chelleen, there appear for the first time those peculiar implements of a amygdaloid form, roughly chipped on both faces; the difference between pollical face and indical face has disappeared. These implements have been styled "coups de poing," and have been considered as a kind of universal instrument. I agree, however, with Herr Klaatsch, that they have rather to be considered as spear heads. We have seen that the first weapon of primitive man was a wooden spear, and that in every probability the spear was the first human implement provided with a stone head. As it is pretty certain that the human beings of the Mesvinien stage used wooden spears only, it is very probable that those of the Chelleen stage, who already practised the bi-faced trimming of their implements, had also made the invention of providing the wooden spear with a stone head. This invention would in all probability have been made during the Strepyien stage—that is to say, at the beginning of the middle quarternay—the Campinien stage in Belgium, towards the end of the second interglacial period in Europe.

During this period for the first time stone was used in the manufacture of arms, while in all the preceding industries its use had been restricted for domestic—sit venia verbo—purposes.

The archaeolithic implements of the Chelleen, as well as the Acheuleen and Mousterien, do not differ in any way from the tronattas, but it is unquestionable that the indical face shows a much more careful treatment.

During the Mousterien stage the spear heads were very carefully finished, and these implements prove that the human beings of the period had already attained a great skill in the treatment of stone—a skill that far exceeded that of archaeolithic man.

And now we come to a very grave problem. The homo mousteriensis Hauseri that has been unearthed at La Chapelle-aux-saints, in France, with a beautifully finished specimen of a coup-de-poing under his left hand, must have been, as his skull conclusively proves, of a much lower type than the Tasmanian race, yet this being used an implement of a much higher type than the Tasmanian, and had in all probability already learnt to provide his spear with a stone head. It is impossible for me to find a satisfactory explanation of these apparently contradictory facts; yet there is no getting away from the fact that the lower developed Mousterien man manufactured implements of a much higher stage than the higher developed Tasmanian, and that the former had already made two inventions which the higher developed Tasmanian never made, viz., the trimming of the implement on both faces, and the providing of the wooden spear with a stone head.

Even if we were to disregard the interpretation of the coup-de-poing as spear head, the fact that this implement denotes a higher stage in the evolution of stone implements than the tronatta remains undisputable. Likewise, the fact that the homo mousteriensis Hauseri represented a much lower type in the evolution of human beings than the Tasmanian race cannot be disputed either.

I think that this is a problem of the gravest kind, inasmuch as it would indicate that though the body can gradually evolve a higher stage, the brain power did not evolve as a corollary. The brain power of the Tasmanian Aborigines still represented the stage of say the human being of the Fagnien period, though his body was in evolution equal to the human beings of the Magdalenien or even a later period. Could we accept the theory that evolution of body does not necessarily go hand in hand with the evolution of brain—and I see no way out of it in face of the above facts—the problem of the evolution of the human race would appear in quite a new light. What agency was it that reacted on the brain of a race still lower than the homo mousteriensis Hauseri to make inventions that the much higher developed Tasmanian could never make; he practically stood at the threshold of the door, but never took the step to enter it.

It cannot be the insular isolation alone that prevented a higher evolution of the Tasmanian race. If the struggle for existence were really the moving agency, the Tasmanians should have reached a much higher stage. Their life was a pretty precarious one; during the winter time the temperature was pretty cold; food was not over common—at least it took a good deal of work to procure the necessary supplies; there were frequent feuds between the different tribes. All this created a hard struggle for existence; yet we do not see that the intelligence of the race made the slightest step forward.

I do not quite see that it can have been the ice, as some scientists assume, that is responsible for the evolution of the human race. For an almost immeasurable time—that is to say from the oligocene past the second glacial period, the evolution of the human beings remained stationary at the archaeolithic stage. There is no difference between an implement from the Mesvinien or the Fagnien industries. Then suddenly an impetus was given right between two glacial periods, and ever since that impetus was given the evolution of the stone implements progressed—slowly at first, but quicker and quicker afterwards.

The Aurignacien industry produced certain kinds of implements, rather long and narrow, that appear characteristic of it. The exact counterpart of these knives occurs among the tronattas. I have in my collection some fine specimens which are absolutely undistinguishable in shape and finish from Aurignacien specimens. The next stage—the Solutreen—which is characterised by the beautiful leaf-shaped implements, gives still numerous archaeolithic implements, but it would go too far to follow them through the more modern stages.

We see, therefore, that archaeolithic implements are not restricted to the oldest industries only; they occur at all periods; even at the early metalliferous period they were still used. But the difference is this, that while the older industries up to the Mesvinien exclusively used the unsymmetrical archaeolithic, the younger industries, from the Strepyien upwards, used the symmetrical palaeolithe in preference to the archaeolithe. It is probably correct to assume that as little as the archaeolithe changed its character, equally little were the manipulations for which it was used changed. The archaeolithe was still used as a scraper, chopper, or knife, but it was, with very few exceptions, never used as a weapon. The symmetrical palaeolithe, of intentional shape, was the weapon.

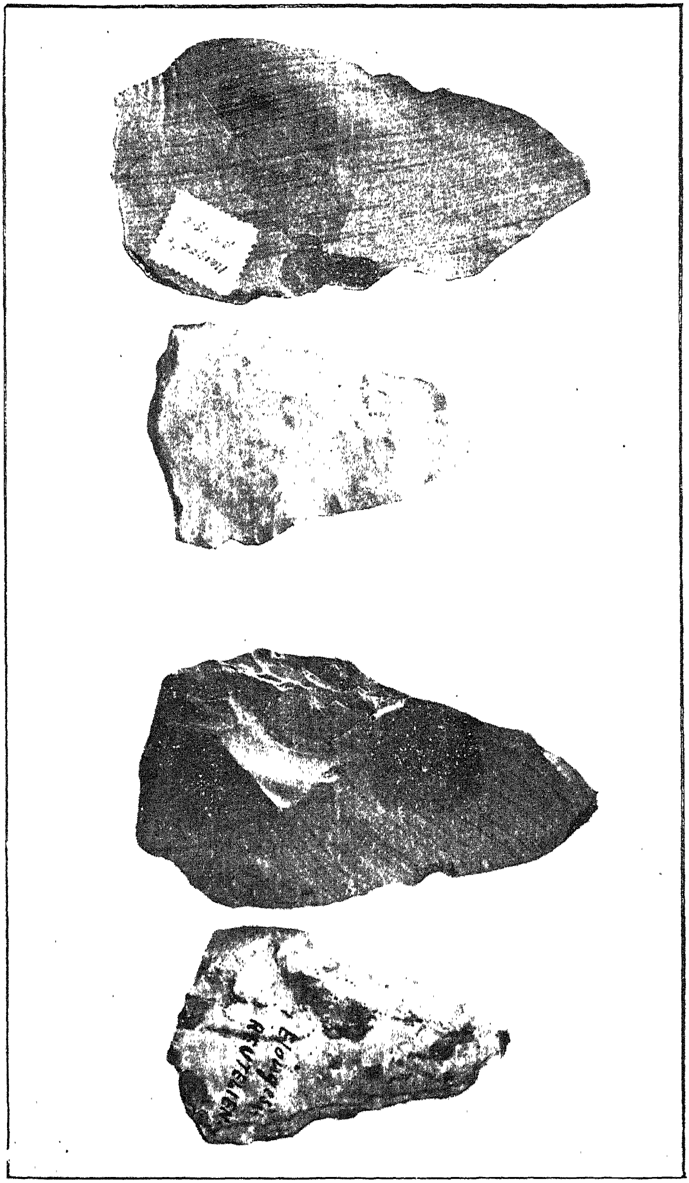
These facts seem to indicate that Mortillet's system is untenable, because forms that are considered characteristic for the different stages occur simultaneously in Tasmania or the Australian continent. Yet it is quite certain that such a view would be erroneous. The stages distinguished in Europe are based on well ascertained geological and palaeontological evidence, and in Australia we must discriminate between two stages at least, viz.—

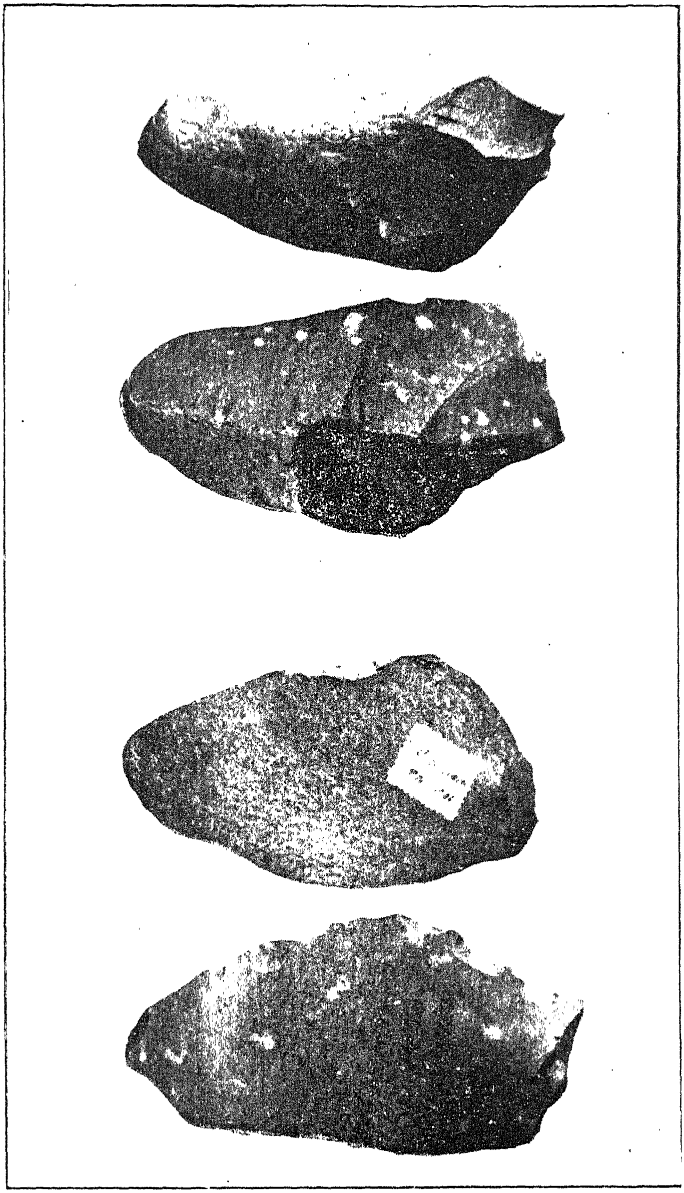
The older—archaeolithic stage without the dingo;

The younger—palaeolithic-neolithic stage with the dingo.

To mix up the European stages would be quite as erroneous as to mix up the two Australian stages, as advocated by Herr Klaatsch. All these stages are chronologically different, and must be kept separate.

Similarity of form does not necessarily prove synchronism. If this were so the Tasmanian civilisation would be synchronogical to the Fagien, or the Aurignacien—in fact to any stage in which archaeolithes were used. Unless corroborated by other evidence, stratigraphical or palaeontological, the age of an industry cannot be deduced from form alone, a fact which has not been generally recognised, but which is conclusively proved by the Tasmanian tronattas.





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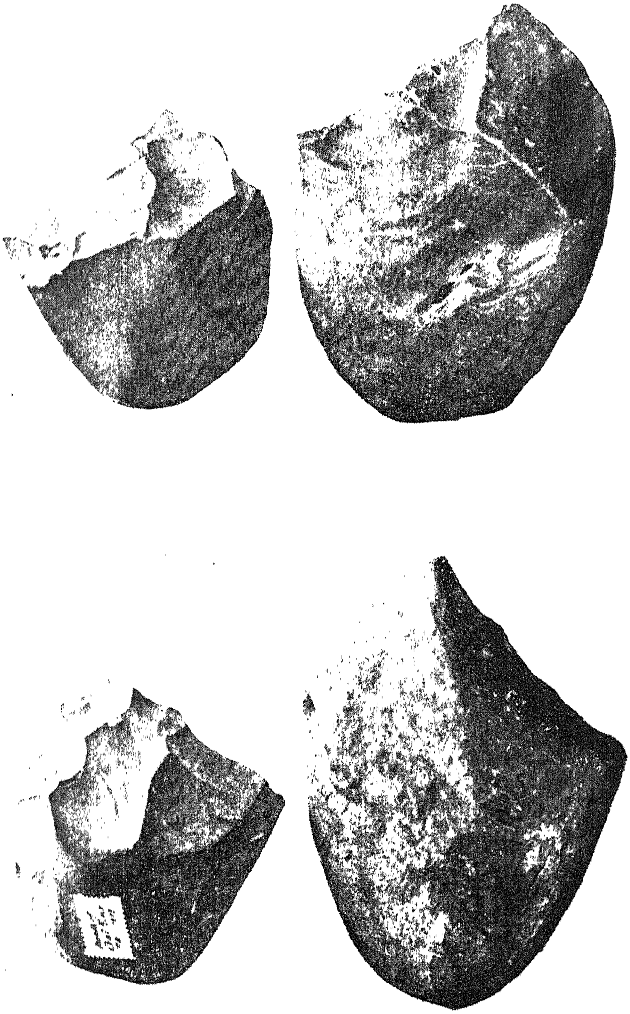

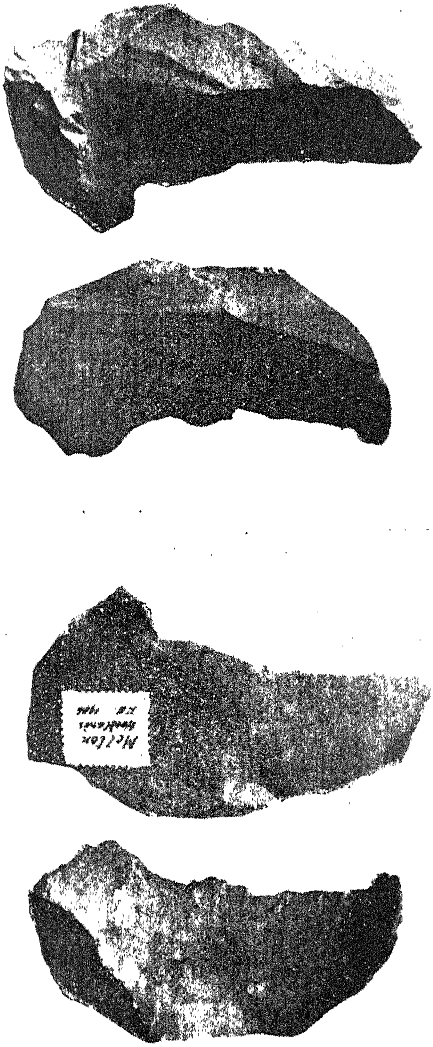
Melton
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THE FOOD OF THE TASMANIAN ABORIGINES.

By Fritz Noetling, M.A., Ph.D., etc.

(Read July 11th, 1910.)

I.—INTRODUCTORY REMARKS.

In a previous paper (1) I made a short calculation as to the quantity of shells that would collect on the refuse heaps within a given time, supposing each person consumed 50 oysters or haliotis per day. The quantity, 36 million shells per year for a population of not more than 2,000 souls, is startling; but subsequently I had my doubts whether such a small quantity, though yielding an enormous number of shells, contained sufficient nourishment to be of material use in sustaining life. A priori it seems that 50 oysters represent such a small quantity of food that this could hardly be considered sufficient, and that it must be supplemented either by other foodstuffs or that the quantity of shell fish consumed must be much larger. If only 100 instead of 50 oysters were consumed, the number of shells produced would just be double the quantity of my previous estimate; that is to say, it would cover a tract of land half-a-mile in width, 10 feet deep for 20 and 32 miles respectively in length. But even 100 oysters are not much to sustain life on, and we will see later on that the number to supply the necessary quantity of nourishment is so large that it is out of question altogether. I therefore went somewhat closer into the study of their diet, with the result hat I have been able to throw some new light on the physiology of that race—a light that will greatly help us in our knowledge of primitive man on the whole.

I am greatly indebted to Dr. George Webster, who not only drew my attention to a valuable paper published by Dr. Harry Campbell on the diet of the primitive races (1), but also gave me some literary references, which were of the greatest value to me. I wish to thank Dr. A. H. Clark for the loan of Thompson's Practical Dietetics, which was of the greatest assistance to me. In it I found all those data necessary to calculate the nutritious value of the food consumed by the Aborigines.

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(1) The Antiquity of Man in Tasmania, Pap. and Proceed. Roy. Soc. Tasman., 1910.

Ling Roth in his classical book on the Aborigines of Tasmania devotes an interesting chapter to the subject of food. His account is based on the evidence of numerous eye witnesses, and it must therefore be considered as a reliable source of information. It is certainly more explicit and accurate than Dr. Campbell's account (l.c. p. 40), which is not free of errors (2).

One source of information with regard to the diet of the Aborigines has not been considered yet, viz., the vocabulary. It is a priori very probable that the vocabulary will contain the names of those substances of either animalic or vegetabilic origin that formed the staple articles of their food. Though it is pretty certain that those animals and plants with which they came in frequent contact, either in a friendly or hostile way, were also distinguished by special names, we may safely assume that chiefly those that were valuable as foodstuffs were specially named.

It will be the best plan first to record the evidence of eye witnesses, and then to see how far this agrees with the evidence of the vocabulary.

II.—EVIDENCE OF DIFFERENT PREVIOUS AUTHORS.

(Summarised from Ling Roth, Aborigines of Tasmania, pag. 85-97.)

All accounts agree that the chief articles of food were meat and shell fish. "The craw-fish and oysters if immediately on the coast are their principal food. Opossums and kangaroo may be said to be their chief support" (1). Cook found they were fond of birds, and Davies (2) states that he saw a female eat sixty eggs of the sooty petrel. He also states that they collected the eggs of the black swan for food (3). The emu was apparently a particularly sought for delicacy.

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(1) The diet of the Precibiculturist, British Medical Journal for 1905, Vol. II., pag. 40, 208, 304, 350, 406, 665, 813, 979, 1,217, 1,658.

(2) For instance, the use of underground ovens, and they certainly made no bark canoes or rafts.

Davies further states that they were very fond of a large white grub (4), found in rotten wood, and that the eggs of the large ants (5) were considered a delicacy.

So far all writers agree, but I can find only one reference (6) that they were "particularly fond of the flesh of the deadly snakes and guana."

It further seems that they never touched fish of any kind. Several writers, like Holman, Lloyd, and Melville are very emphatic on this point, and their evidence is in some way supported by the fact that no fish bones were so far found in the kitchen middens. They were, however, experts in spearing fish, and one of the few of their legends that are handed over to us describes a deadly fight between a man and the dreaded stinging ray (Urolophus cruciatus).

Not one of the authors quoted by Ling Roth even hints that they consumed the flesh of Dasyuridae, viz., Thylacinus cynocephalus (the so-called tiger), Sarcophilus ursinus (the so-called devil), Dasyurus maculatus (the native cat), and Dasyurus viverrinus. They neither consumed the Monotremata, viz., Platypus and Echidna.

It is undoubtedly very remarkable that even at the low state of civilisation represented by the Aborigines, human beings preferred the flesh of the herbivorous animals, and declined to eat that of the carnivorous. The kangaroos, the wallaby, the wombat, and Phalangista (1) are all vegetabilic feeders, and certainly formed the staple articles of food. On the other hand, they apparently did not disdain insectivorous animals like Perameles Gunnii (the kangaroo rat). Considering that they made such a distinction in the selection of meat, and that they showed an unquestionable preference for herbivorous animals, it may be questioned whether they were really so fond of "the deadly snakes and the guana" as Melville states them to be.

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(1) Widowson, Present State of Van Diemen's Land, London, 1829.

(2) Davies, on the Aborigines of Van Diemen's Land, Tasm. Journ. Nat. Science, Vol. II., 1846.

(3) In addition to the eggs they certainly consumed birds, as proved by the numerous bones found in the Rocky Cape cave deposits.—F. N.

(4) Most probably the larvae of Zeuzera eucalypti.

(5) Probably Diamma bicolor.

(6) Melville, Van Diemen's Land, comprising a variety of statistical and other information, Hobart, 1833.

With regard to the vegetabilic food, Ling Roth is certainly mistaken if he says that the edible productions abound in their island, and the error seems to have arisen out of Gunn's (2) paper and the list of "Plants that 'could' have been used for food by the original Tasmanian natives," supplied by the Government Botanist of Victoria to Brough Smyth (3). No doubt all these plants occur in Tasmania, but whether they were habitually used as food by the Aborigines seems rather doubtful (4).

All writers agree that their chief vegetabilic foods were the pith of the fern tree, the roots and young shoots of the braken fern, besides various fungi, for instance the truffle-like Mylitta australis; the leaves and tubers of various orchids, particularly those of Gastrodi sessamoides, the roots of Geranium parviflorum; the seeds of different acacias all these entered largely into their diet. But there is no doubt that the most common of all these vegetables obtainable all the year round were the ferns, Cibotium Billardieri, Alsophila australis, and Pteris esculenta.

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(1) In Australia Phalangista is usually, but wrongly, called opossum. I need hardly to point out that it has nothing whatsoever to do with the true "opossum," which are a family of the Rapacia, of which the Dasyuridae are the Australian representatives, while the Phalangista belongs to the Carpophagae.

(2) Remarks on the indigenous vegetable productions of Tasmania available as food for man, Tasman. Journ. of Nat. Science, 1842, Vol. I., pag. 35-52.

(3) Aborigines of Victoria, Vol. II., pag. 394.

(4) When Dr. Campbell states that the Aborigines consumed 37 different kinds of vegetables, he probably referred to Brough Smyth's list, overlooking that this was a list of plants that "could" have been used, but not a list of plants that "were" used. Inter lineas, it may be remarked that this list comprises not less than 108 species.

I may also mention that according to Bunce (1) "the natives obtained from the cider trees (Eucalyptus resinifera) of the lakes a slightly saccharine liquor resembling treacle (2). At the proper season they ground holes in the tree, from which the sweet juice flowed plentifully. It was collected in a hole at the bottom near the root of the tree. . . . When allowed to remain any length of time, it ferments and settles into a coarse kind of wine or cider, rather intoxicating if drunk to excess" (3).

III.—THE EVIDENCE OF THE VOCABULARY.

I originally intended to give the native names of the animals, birds, and plants contained in the different vocabularies, but I soon found that this was unfeasible. The different vocabularies give such different names for one and the same animal that only the trained philologist will be able to ascertain which is the correct one. For instance, Norman's vocabulary gives under the heading "kangaroo" (4) the following words:—

1. terrar.
2. woolar.
3. iilar.
4. pleathenar.

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(1) Bunce, Twenty-three years' wanderings in the Australias and Tasmania, Geelong, 1857. (Published also in Melbourne under the title Australasian Reminiscences, 1857.)

(2) Which, according to Milligan, was called wayalinah.

(3) I commend this fact to the notice of those who wish to reform mankind by the total prohibition of all alcoholic drinks. The craving of the human body for alcohol cannot be better illustrated than by the example of this primitive type of human beings. It does not matter in the least, whether they found out accidentally or not, that the sweet juice of a certain tree yielded, on being allowed to stand for some time, a liquor that had a peculiar effect on the system. They had discovered this fact, and they made use of it, probably to a much greater extent than we know of.

(4) The wallaby (H. Billardieri) is not mentioned at all in Norman's vocabulary.

Milligan quotes the following:—

	Eastern Tribes.	Southern Tribes.	N. and N.W. Tribes.
Forester Kangaroo (Macropus major)	ne-wittye	tarrana	tarraleah
Brush Kangaroo (Halmaturus Bennettii)	oaleetyaree-ena or lyenna	lazzah-kah	kuleah
Wallaby (Halmaturus Billardieri)	lukangana or lakanguna	taranna or tarra	noguoyleah or tahah

This number of names for three animals which are so easily distinguishable is formidable enough, but it gets worse when we consult the others. According to Ling Roth we have the words:—

1. lalliga (Dove, Jorgensen, Brain)
2. lemmook, male kangaroo (ditto)
3. lurgu, female kangaroo (ditto)
4. lelagia (McGeary).
5. leina (Roberts)
6. taramai (Gaimard)

all of which denote kangaroo, and the wallaby is distinguished by the words

7. tarana (Roberts)
8. tana (Dove, Jorgensen, Brain).

We have therefore 25 words for three animals!

This number can, however, be reduced to 16, because terrar, tarrana, taranna, tarra, tarana, tana, tarra-leah, tanah, as well as lalliga and lelagia and lukangana and lakanguna are unquestionably one and the same word. But we find still other difficulties quite apart from the etymological ones. According to Milligan the eastern tribes called the Great or Forester kangaroo, the largest animal of Tasmania, "newittye"; but if we peruse his vocabulary we find that "Seal (Phoca) on sandy beach" is called "naweetya." I do not think that anybody will dispute the fact that these two words are identical; but I also think that everybody will agree with me if I say that it is impossible that one and the same tribe called two animals that could hardly be more different than the great kangaroo and the seal, by one and the same name. The word "naweetya" gave me, however, a clue; it is unquestionably the same word as "noattye." Now, we know that the negative is expressed by the word "noia" or "noattye," and I think it therefore very probable that Milligan's informant when questioned as to the names of these animals simply replied naweetye(a), "I do not know."

From the above list it further appears that the Aborigines, at least the southern and northern tribes, had no distinguishing names for the Great Forester kangaroo and the wallaby. Both were tara or tara-na. Now, I do not think it very probable that if they did not distinguish between these two animals whose habitat is widely different (1), they would have distinguished the Brush kangaroo, which is much closer related to the Forester, from the latter animal.

Another instance will still more emphasise the discrepancies of Milligan's vocabulary. According to it the word for fern tree is in the eastern dialect "nowarra-comminea," but the same tribe calls the small hawk (Astur approximans) "nowarra-nenah." I fail to discover anything in common between a fern tree and a small hawk; if both had any common quality the word "nowarra" might be accounted for; but as there could be hardly anything more different than a bird and a fern tree, the peculiar similarity of these words had first to be explained before we could accept them as correct (2).

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(1) The forester inhabits the open eucalyptus forest, while the wallaby lives in the dense scrub of the valleys.

(2) There are some other remarkable anomalies. According to Milligan the southern tribes called the large owl (Strix castanops) "rokatah," from which the word cockatoo is unquestionably derived. The birds the Europeans call by this name were called "weeanoobryna" or "oiynoobryna" by the eastern tribes, and "'nghara" or "oorah" by the southern tribes.

The popular word for Spheniscus minor, the penguin, is apparently derived from "teng-wynne," the word in the eastern dialect for this bird. The most curious coincidence exists, however, in the words for dog (spaniel) and gosling. The dog is "kaeeta," and the gosling "kaeeta-boena." As we know for certain that there were no indigenous dogs in Tasmania, and that the Aborigines became acquainted with this useful animal only through the Europeans, the mental process which brought a dog and a gosling together is rather a curious one.

It is to be hoped that Mr. Hermann B. Ritz, who has already done such a lot of good work in explaining the language of the Aborigines, will throw some light on these anomalies.

Till then, and till all the discrepancies are cleared, I prefer not to give the names of the animals and plants distinguished by the Aborigines, but to summarise the facts ascertained from the vocabulary.

The Aborigines distinguished by different words:—

A.—Animals.		
1. Mammalia	25	species (1)
2. Reptilia	4	,,
3. Amphibia	1	,,
4. Aves	53	,,
5. Pisces	5	,,
6. Crustacea	3	,,
7. Insecta	13	,,
8. Mollusca	12	,,
9. Vermes	2	,,
B.—Plantae	11	,,
Total	129	,,

That is to say, about 12 per cent. of the number of words enumerated in Calder's vocabulary and 15 per cent. of the words contained in Milligan's vocabulary.

We will now consider the different classes separately:

1.—MAMMALIA.

The following 25 species have been distinguished:—

1.	Ant-eater	Echidna setosa.
2.	Bandicoot	Parameles obesula (2)
3.	Bat	Vespertilio tasmaniensis.
4.	Native Cat	Dasyurus maculatus.
5.	Tiger Cat	Dasyurus viverrinus.
6.	Native Devil	Sarcophilus ursinus.
7.	Dog	Canis sp. (domesticus).
8.	Forester Kangaroo	Macropus major.
9.	Brush Kangaroo	Macropus Bennettii.
10.	Mouse	Mus tasmaniensis (?).
11.	Kangaroo Rat	Hypsoprymnus apicalis.

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(1) Including the imported dog.

(2) Including P. Gunnii.

12. Black Opossum..	Phalangista fuliginosa (1).
13. Ring-tailed Opossum..	Phalangista viverrina.
14. Opossum Mouse	Phalangista nana.
15. Porpoise	(?)
16. Platypus	Ornithorhynchus paradoxus.
17. Water Rat	Hydromys chrysogaster.
18. Rat (long tailed)	(?)
19. Seal (Phoca) on sandy beach	(?)
20. Seal (black) on rocks	Arctocephalus lobatus.
21. Seal (white-bellied)	Stenorhynchus leptonix.
22. Tasmanian Tiger	Thylacinus cynocephalus.
23. Wallaby	Halmatūrus Billardieri.
24. Whale	(?)
25. Wombat	Phascolomys wombat.

Milligan's list of words is by no means very satisfactory, and rather carelessly compiled. We find, for instance, that the two species of Dasyurus occur under two different headings, viz., Cat (large native), Cat (small native), and again Native Cat (large), Native Cat (small), and the first time the Dasyurus masculatus is called luyennah, and the second time this name is given to Dasyurus viverrinus.

The name for mouse again occurs later on under the heading Rat, long bandicoot nose; the same applies to Echidna setosa, which is first referred to as "ant eater," and later on as "porcupine." The "rat" mentioned on page 39 is apparently the same as the "long-tailed rat" on page 40, and it need hardly to be mentioned that the words "dog" and "spaniel" are the same.

Though Milligan enumerates 30 names of mammals, these represent only 25 different species, as above mentioned. These 25 species, or, if we omit the whale and the porpoise, practically represent the whole of the mammalian fauna occurring in the island, a fact which proves that the mammals must have played a great role in the life of the Aborigines.

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(1) Including the common or grey opossum, Phalangista vulpina. The grey opossum is, and probably was, much more common than the black one. If the Aborigines did not distinguish between a grey and a black opossum, is it probable that they would have given different names to the great and the brush kangaroo, which are much more alike than the black and the grey opossum?

2 & 3.—REPTILIA AND AMPHIBIA.

Only five species were distinguished, viz.:—

1.	The Iguana (1)	Tiliqua nigrolutea.
2.	Another Lizard	Homolepida casuarinae (?).
3.	The Black Snake	Hoplocephalus curtus.
4.	The Diamond Snake	—
5.	The common Frog	Rana spec.

This list is a meagre one, but it is hardly astonishing that we find two such dangerous reptiles as the black and the diamond snake distinguished under special names. The formidable looking, though quite harmless iguana, which is so common in Tasmania, could also not fail to escape their notice, as well as the common frog, whose native designation, rallah, is decidedly of onomatopoetic origin.

4.—AVES.

The following 53 species are enumerated by Milligan:

1.	Albatross	Diomedea exulans.
2.	Bald-coot	Porphyrio melanotus.
3.	Cobbler's-awl	Acantorhynchus tenuirostris.
4.	Cockatoo (white)	Cacatua galerita.
5.	Cockatoo (black)	Calyptorhynchus funereus.
6.	Crow	Corvus coronoides.
7.	Wild Pigeon (Dove)	Phaps elegans.
8.	Wild Duck	(?)
9.	Eagle	Haliaetus leucogaster.
10.	Eagle (Osprey)	Pandion leucocephalus.
11.	Eagle (wedge-tail)	Uroaetus audax.
12.	Emu	Dromaecus Diemenensis.
13.	Firetail	Estrelda bella.
14.	Gannet	Sula australis.
15.	Cape Barren Island Goose	Cereopsis nov. Hollandiae
16.	Gull	Larus pacificus.
17.	Native Hen	Tribonyx Gouldi.
18.	Hawk	Hieracidea orientalis.
19.	Small Hawk	Astur approximans.
20.	Egret	Herodia syrmatophorus.
21.	Heron	Ardea nov. Hollandiae.
22.	Honeysucker	Meliphaga australasiana.
23.	Kingfisher	Alcyone Diemensis.
24.	Magpie (Shrike)	Gymnorhina organicum.
25.	Magpie (black)	Strepera fuliginosa.
26.	Mountain Duck	Anas punctata.

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(1) According to Milligan's vocabulary the eastern tribes called this animal Lyennah—that is to say, by the same name as that given to Halmaturus Bennettii.

27.	Musk Duck	Biziura lobata.
28.	Mutton Bird	Puffinus tenuirostris.
29.	Owl (large)	Strix castanops.
30.	Owl (small)	Athene boobook.
31.	Parrot (green)	Platycercus flaviventris.
32.	Parrot (rosehill)	Platycercus eximius.
33.	Parrakeet (swift)	Lathamus discolor.
34.	Parrakeet (musk)	Trichoglossus concinnus.
35.	Parrakeet	Euphema chrysostome.
36.	Pelican	Pelicanus conspiculatus.
37.	Penguin	Spheniscus minor.
38.	Pewit (wattled)	Lobivanellus lobatus.
39.	Bronzewinged Pigeon	Phaps chalcoptera.
40.	Quail	Coturnix pectoralis.
41.	Rail	Rallus pectoralis.
42.	Redbreast (Robin)	Petroeca phoenicea.
43.	Sandlark	Hiaticula ruficapilla.
44.	Black Cormorant	Phalacrocorax corboides.
45.	White-breasted Cormorant	Phalacrocorax leucogaster.
46.	Swallow	Hirundo neoxena.
47.	Swan (black)	Chenopis atrata.
48.	Thrush (spotted)	Cinclosoma punctatum.
49.	Thrush (dense forest)	Geocichla macrorhyncha.
50.	Wattle Bird	Acanthochaera inauris.
51.	Wattle Bird (smaller)	Acanthochaera mellivora.
52.	Wren (blue headed)	Malurus longicaudus.
53.	Red Bill	Haematopus fulginosus.

As already stated it seems a large number, but if we go through the list we find that it practically contains all the more common birds of Tasmania. No doubt most of them, in particular the sea birds, supplied the eggs, and if the birds were caught they were eaten just as well, as the remains in Rocky Cape cave prove. The most important bird was, however, the emu, which formed one of the staple articles of their diet.

5.—PISCES.

Only five species are mentioned:—

1.	Eel	Anguilla australis.
2.	Flounder	Rhombsolea monopus.
3.	Ray (Stingaree)	Urolophus cruciatus.
4.	Seahorse	Hippocampus abdominalis.
5.	Shark	Genus uncertain.

All authors agree that fish did not form one of the articles of their diet, and it is hardly to be wondered at that only such a small number were named. It is interesting to note that the same words are used for "flounder" and the stinging ray, namely, lerunna (flounder) and leranna (ray). The last-named fish was one of those they dreaded most, but apparently when asked the name for flounder they gave it the same name as the ray, because of the similarity in shape and its habit to rest flat on the bottom of the sea. It is somewhat astonishing that they should distinguish the hippocampus under a separate name, because this fish can hardly be considered a very prominent representative of the fauna. It is very probable that on closer examination the native word will have quite a different meaning.

6.—CRUSTACEA.

Three species are mentioned, viz.:—

1.	The large Crab	Pseudocarcinus gigas.
2.	The Crayfish	Palinurus Edwardsii.
3.	The Freshwater Lobster.	Astacopsis Franklinii.

Though small, the above list is very significant. At least two, the crayfish and the fresh water lobster, were consumed, the latter being of a particular sweet taste, equal in flavour to, if not better than, the greatly appreciated Astacus fluviatilis of Europe. The large crab is a remarkable object, which cannot fail to attract anybody's attention. That they distinguished it by a name is therefore hardly surprising, but there is no record that they also ate it.

7.—INSECTA (1).

There are five insects mentioned, viz.:—

1.	Large blue ant	Diamma bicolor.
2.	Largest venomous rat	Myrmecia pyriformis.
3.	Small black	Colobopsis Gasseri (?).
4.	Red body and black head	Camponotus consobrinus (?).
5.	Blow fly	Calliphora oceanicae.
6.	Caterpillar	Genus and species uncertain.
7.	Flea	Pulex irritans.
8.	Locust	Chortoicetes terminifera (?).
9.	Spider	Genus and species uncertain.
10.	Tarantula	Genus and species uncertain.
11.	Tick	Ixodes (spec. uncertain).
12.	White grub	Zeuzera eucalypti.
13.	Mole cricket	Gryllotalpa coarctata.

When we go through this list we will see that with a few exceptions only the names of insects are recorded that are annoying to human beings. Anybody who has been in the Tasmanian bush knows how annoying, for instance, blow flies and ticks can be.

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(1) I am greatly indebted to Mr. A. Lea for the scientific determination of the somewhat vague popular words.

The number of ants distinguished is remarkably large, but we find that the native words are all combinations of the word "tietta" or "teita" with another word. Considering that the eggs of these insects were delicacies, it is hardly surprising that they distinguished such a large number. The "white grub," which was also considered a delicacy, is distinguished from the ordinary caterpillar (1).

9.—VERMES.

Only two species are distinguished, viz.:—

1. The leech
2. The common earth worm.

The first is a particularly objectionable inhabitant of the Tasmanian bush, which must have greatly worried the naked Aborigines; and the second is so common an object that it cannot fail to attract notice. It is pretty certain to assume that neither served as food.

10.—MOLLUSCA.

The last group of animals, but not the least important one, includes the names of 13 species, viz.:—

1. Chiton (2)	Chiton pectolatus.
2. The Mutton Fish	Haliotis tuberculata.
3. The Mutton Fish	Haliotis glabra.
4. The Limpet	Patella tasmania.
5. Mussel	Mytilus latus.
6. Aragonauta	Aragonauta nodosa
7. Oyster	Ostrea edulis.
8. Periwinkle (3)	(?)
9. Turbo	Turbo (Marmorostoma) undulatus.
10. Triton	Triton spengleri.
11. Voluta	Voluta mamilla.
12. Voluta	Voluta fusiformis.
13. Wherry	(It is impossible to say what species was understood by this name).

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(1) I might again draw attention to another of the anomalies in Milligan's vocabulary. The ant-eater (Echidna setosa) is called mung-yena or moynea by the eastern tribes, and in the same dialect a grub is called mung-wenya or menia.

(2) There are several species of Chiton, but Ch. pectolatus is the most common.

(3) It is difficult to say what kind of gastropod was understood under this name, probably one of the larger species of Fusus or Fasciolaria.

We know that most of these species, perhaps with the exception of the Argonauta and the large Triton and Volutas, were consumed, and it is therefore hardly astonishing that they were distinguished under separate names (1).

The evidence of the vocabulary is fully borne out by the shell heaps. We find all the specimens above enumerated, in addition to a number of smaller species, which most probably were accidentally mixed with the larger kinds. The absence of the valves of the Pectines will be referred to later on.

B.—PLANTAE.

The names of 11 plants only are given, which is a very small number considering the richness of the flora (2). These are:—

1.	.. ..	Blanfordia nobilis.
2.	The Bracken fern	Pteris esculenta.
3.	The Fern tree	Cibotium Billardieri.
4.	Wattle tree	
5.	Gum tree	Eucalyptus spec. spec.
6.	Mushroom	
7.	Sheoak	
8.	Blackwood tree..	
9.	Bullrush	Typha.
10.	Waratah	Telopea truncata.
11.	Acacia	Acacia maritima.

The above list proves more than anything what a small role the vegetabilic kingdom played in the life of the Aborigines. It is mostly the plants they consumed as food and those that they came daily across that were named.

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(1) I think, however, that a critical examination will reduce the number of names. How careless Milligan's vocabulary is sometimes compiled will be seen from the following. Pag. 30 he says:—

		East. Tribes	West. Tribes
Haliotis (ear-shell)	H. tuberculata H. glabra	yawarrenah	netepah

and on pag. 36 we read:—

Mutton-fish, smooth—(Haliotis)	magraunyah	lorokakka
Mutton-fish, rough—	yawarrenah	teeoonah

Now, which version is the correct one?

(2) I mentioned above that Brough Smyth quoted on the authority of the Government Botanist of Victoria not less than 108 different species occurring in Tasmania which could be used as food.

The absence of a name for the greatly appreciated fungus, Mylitta australis, is rather strange, and difficult to account for. We know that up to the present day this fungus is popularly called "native bread," but I cannot find any word under that heading. There is a word for bread, "pannaboo" or "pannaboona," but as we know that bread was unknown to the Aborigines until they came in contact with the Europeans, we must either assume that this word signifies the Mylitta australis or, as I rather feel inclined to believe, that it is an adopted word (1).

A further omission is also remarkable: Billardiere refers to Fucus palmatus and ficoides as being favourite vegetables. No name can be found in any of the vocabularies.

All evidence tends to prove that the Aborigines existed mainly on a meat diet, consisting of the following classes:—

A.—MAMMALS.

1. Kangaroo (2 species).
2. Wallaby.
3. Opossum (3 species).
4. Wombat.
5. Seals (3 species).
6. Kangaroo rat.

It is certain that they never touched any of the carnivorous animals, though they distinguished them by names. There is also no record that they consumed the Prototremata, Echidna and Platypus, though both animals were well known to them.

B.—BIRDS.

Besides the emu, which probably formed one of the staple articles of food, a large number of birds were distinguished by them. Though the bones of birds are rather common in the cave deposits near Rocky Cape, in particular the sea birds, they were probably hunted less for solid food than for their eggs (1).

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(1) Can it be possible that it is a corrupted form of the French "pain"?

C.—MOLLUSCA.

1. Oyster.
2. Mutton fish (Haliotis).
3. Mussel.
4. Turbo.
5. Limpets.

Besides this five kinds, of which the oyster and the Haliotis are the most important, they apparently consumed also a number of smaller kinds, which were probably brought up together with the larger specimens. There is, however, a very strange and almost unaccountable absence of three of the most conspicuous mollusca of the present fauna, viz., the three large Pectines:—

Pecten asperrimus,
Pecten bifrons,
Pecten meridionalis,

the last being the now highly appreciated scallop. No names of these species appear in the vocabulary; neither have I ever found any of their valves in the shell heaps. This is particularly conspicuous in the shell heaps along the Derwent, where all these species are very common at present, while the Ostrea has almost disappeared. We must therefore either assume that the Pectines came to the Derwent after the disappearance of the Aborigines, or that the latter for some reason or other disliked this kind of mollusca (2).

D.—CRUSTACEA.

The common Palinurus Edwardsii of the Tasmanian coast, as well as Astacopsis Franklinii of the rivers, seem also to have been consumed, though both apparently does not come anywhere near in importance to the other three classes.

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(1) There is a remarkable survival of the diet of the Aborigines in the ordinary diet of the present population. Puffinus tenuirostris, the sooty petrel, or as it is popularly called, the "mutton bird," is a very favourite dish. To my taste it is too greasy, as it contains a large percentage of fat; but it is probably on this account that it was consumed by the Aborigines.

(2) The above is a question of greatest interest, but further investigations will have to be made before anything definite can be said.

E.—INSECTS.

The fatty, oily larva of Zeuzera eucalypti was when found apparently much appreciated, though it probably did not enter into the regular diet, as well as the eggs of ants.

F.—VEGETABILIC FOOD.

Their vegetabilic food was unquestionably much less varied than their animalic food, the forest of Tasmania being devoid of those kind of trees like the oak, the beech, and the hazel tree, whose nuts formed such an important part in the diet of palaeolithic man in Europe (1). Though, according to Brough Smith, 108 different kinds of edible plants occur in Tasmania, this does by no means prove that all served as food to the Aborigines. The principal plants used were—

1. Pteris esculenta (the common or bracken fern).
2. Cibotium billardieri (the common fern tree).
3. Alsophila australis (the rarer species of fern tree).
4. Mylitta australis (the so-called native bread).
5. Fucus palmatus (the sea wrack).
6. Gastrodi sessamoides (the native potato).

Besides these six species they consumed the tubers of several of the orchids; mushrooms, the seeds of several species, particularly of the Acacia sophora and others, which were freely eaten.

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(1) How important the role these nuts played in the household of palaeolithic man must have been will be seen best if we examine their fuel value per pound. According to Langworthy the fuel value per pound of

Filbert nuts is	3,432 cal.
Beech nuts	3,263 cal.
Acorns	2,718 cal.

If we consider that the fuel value per pound of beef is 1,130 cal., that of wheat flour 1,640 cal., and that of potatoes only 385 cal., the importance of the above kind of nuts in the diet of palaeolithic man is obvious, particularly if we remember that beech and oak grow abundantly in Central Europe, and that a good harvest was always certain.

The fern trees were split, and the core or pith was eaten, probably after being roasted; the young shoots of the Pteris esculenta, but in particular the roots, which were roasted, appear to have been their staple vegetabilic food. If available, the truffle-like fungus Mylitta australis seemed to have been greatly valued.

The other plants mentioned were probably only eaten when available, but they always could depend on a good supply of fern trees and fern roots.

IV.—THE NUTRITIOUS VALUE OF THE DIET OF THE ABORIGINES.

We will now examine the value of their diet from a physiological point of view. Unfortunately the data on which we can base our researches are very scanty. There is, as far as I know, not a single analysis made of the meat of the animals above mentioned. It is, however, probably not too far out if we assume that the meat of kangaroo or wombat (1) has somewhat the same percentage of protein, fats, and carbo-hydrates as lean beef.

According to Parkes, beefsteak contains:—

	Per Cent.
Water	74.4
Protein	20.4
Fats	3.5
Carbo-hydrates	Nil
Salts	1.6

We are somewhat better informed as to the composition of the shell fish, of which we may take the oyster as the type. According to Woodruff oysters (2) contain—

	Per Cent.
Water	87.1
Protein	6.0
Fats	1.2
Carbo-hydrates	3.7
Salts	2.0

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(1) Kangaroo, in particular wombat, meat, is very dry, lean, and contains hardly any fat. Whatever its percentage of protein may be, its percentage of fats must be small.

(2) As far as I can find out oysters seem to be the only animalic food that contains carbo-hydrates, and what is more, to such an extent that they amount to nearly 66 per cent. of the protein. It is probably on account of this high percentage of carbo-hydrates that the Aborigines so eagerly consumed oysters and other shell fish, because their full value of 230 cal. per pound is amongst the lowest of all food stuffs.

Though nothing is known as to the nutritious value of emus, swans, and other eggs, we may take it that they do not differ very much from an ordinary egg, which contains—

	Per Cent.
Water	73.5
Protein	13.5
Fats	11.6
Carbo-hydrates	—
Salts	1.0

All data are wanting with regard to the vegetabilic food. Nothing is known about the percentage of carbohydrates in the pith of the fern tree or the root of the common fern, but we may take it that it consists mostly of woody fibre, and that the percentage of carbo-hydrates is less than that of cabbage, viz., 5.8 per cent.

As the Mylitta australis is a kind of truffle, the composition of this fungus should serve as a guide. It contains:

	Per Cent.
Water	72.08
Non-nitrogenous substances	16.45
Fat	0.62
Woody Fibre	7.92
Ash	2.21

We will further assume that the tubers of the orchids contain 10.1 per cent. of carbo-hydrates, like the onion, though this is certainly too high an estimate. It is, however, pretty certain that except in the Mylitta australis and other fungi, as well as the tubers of the orchid, not one of the vegetables consumed by the Aborigines contained carbo-hydrates in any appreciable quantity. We will further assume that the average person requires per day—

		Grams.
Water		2,800
Solids, viz.—		
(a) Protein	130	618
(b) Carbo-hydrates	404	
(c) Fat	84	

The actual figures vary somewhat with age and sex, as well as with the work. The maximum sems to be 824 grams., the minimum 460 grams., of solids. In order to keep the metabolic equilibrium it seems, however, necessary that the ration of Proteids (nitrogeneous food) to the non-nitrogeneous food (carbo-hydrates and fats) should be 1:3.5 in the minimum and 1:4.5 in the maximum. We will now see how far the diet of the Aborigines answers the above requirements.

We will return to the original estimate, and assume that while on the coast the average consumption was 50 oysters per day per individual. The average weight per oyster may be taken at ¼ ounce, four oysters to go to the ounce; 50 oysters weigh therefore 12½ ounces=354 grams. (1). They contain therefore—

		Grams. (2)
Water		308
Protein	21	45.7 solids.
Fats	4	
Carbo-hydrates	13	
Salts	7	

In order to obtain the necessary 130 grams Protein, 6.12 x 50=306, say 300 oysters, weighing 2,166 grams.= 4¾ lbs. in the aggregate, had to be consumed. These oysters would contain—

		Grams.
Water		1,850
Protein	130.00	276.46 solids.
Fat	25.74	
Carbo-hydrates	78.54	
Salts	42.48	

We therefore see that though oysters contain a remarkably high percentage of carbo-hydrates for animalic food, the deficiency of the necessary quantity is—

325 grams in the carbo-hydrates
58 grams in the fats.

If this deficiency be made good on an exclusive oyster diet, about 30 times the above quantity, viz., 1,500 oysters, weighing about 11 kilogram, that is to say more than 24 lbs., would have to be consumed per day by one individual. It is obviously absurd to assume that this was possible, but even if it were possible there would be such an excess of proteids that the rates of the nitrogenous to non-nitrogenous substances would be 1 : 0.8 instead of 1 : 3.5.

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(1) Even this is perhaps too high an estimate.

(2) Omitting decimals.

There is no doubt that no human being could exist on such a diet, and it would have either to alter it or to perish.

We can take it as pretty certain that the required quantity of protein was not solely supplied by shell fish food, even if they were plentiful. An average consumption of 300 oysters, not to speak of 1,500, per day per head would soon exhaust even the richest shell beds. We may therefore take it that the daily consumption was considerably under 300 oysters. If we take it at 50 oysters only we have seen that even this small number produces in 5,000 years such a quantity of shells as to cover a tract of land of half a mile in width and 10 miles in length 10 feet deep (1).

This number of shell fish is, however, not sufficient to sustain life, other more solid food was required. A crayfish may have often helped, but it did not materially alter the above figures, as it added only more Protein, but none of the other substances. We will assume that in addition to the oysters each person consumed 1 kilo=2.2 lbs. of meat of sorts (kangaroo, wombat, etc.). The quantity contains—

		Grams.
Water		744
Protein	205	240 solids.
Fats	35	
Carbo-hydrates	—	
Salts	16	

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(1) In five thousand years 1,500 oysters per day per individual would form a shell heap half-a-mile in width, 10 feet deep, and 300 miles in length; or, if we were to assume that the layer was not thicker than 1 foot, the shells would cover an area of 1,500 square miles. In 100,000 years more shells would have been produced as to cover the whole island with a layer of one foot in thickness! Even if we were to take the minimum number of 50, the shells produced in 100,000 years would be sufficient to cover more than one-fifth of the present island by a layer of one foot in thickness.

If 50 oysters were daily added to the meal this quantity of food would contain—

		Grams.
Water		1,052
Protein	226	278 solids.
Fats	39	
Carbo-hydrates	13	
Salts	23	

Two facts are obvious; the above quantity of food does not contain a sufficient quantity of solids to sustain life, and what there is contains Protein in excess, while the non-nitrogenous substances are insfficient altogether (1). This will be still better illustrated if we calculate the fuel value.

	Calories.
Protein, 226 gram.	= 926.6
Fats, 39 gram.	= 362.7
Carbo hydrates, 13 gram.	= 53.3
Total	1,342.6

According to Mrs. E. H. Richards, the ration to barely sustain life contains—

	Gram.
Protein	75
Fats	40
Carbo hydrates	325

and is equal to 2,000 calories.

A Tasmanian who consumed 1,354 gram. of meat and oysters would therefore still be short of 857 calories in order to barely sustain life (2). How is he to make good this shortage? Another 50 oysters supply not more than 176 calories. Another kilogram of meat would supply 1,165 calories. Therefore, if he were to consume 2,708 gram.=5½lb. meat and oysters, the potential energy of his food would be equal to 2,683 calories—that is to say, about the same as that of the German soldiers on peace footing, whose fuel value represents 2,827 calories. A reference to the diet of the German soldier will, however, show that it is more judiciously composed, inasmuch as the ratio nitrogenous to non-nitrogenous is 1:4.6—5, and that it contains 641—893 gram. solids, while our Tasmanian consumes 627 grams. of solids only, and the ratio nitrogenous to non-nitrogenous substances is 1:0.23.

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(1) Chittenden says: To consume protein in excess of that required for the repair of the tissues is a physiological sin, the wages of which is migraine in earlier life and cardio-vascular degeneration in the later. Is it probable that the exclusive protein diet of the Aborigines is largely responsible for their rapid disappearance?

(2) The potential energy of his nutrients would still be lower than that of a sewing girl of London, who sustains life on 1,820 calories, or the factory girl of Leipzig, who does the same on 1,940 calories.

It is more than questionable whether the Tasmanian race could have existed on a diet of so small a potential energy as 1,342.6 calories if we consider the active life they led, particularly when their food contained such an excess of protein.

They may have, and they certainly did, supplement their diet by eggs; but considering that eggs contain 13.5 per cent. protein, this would only tend to increase the quantity of protein in a diet which is already too rich in these substances. It is true eggs contain 11.6 per cent. of fat, but this substance could comparatively easily be supplied by consuming the more fatty animals like seals, or the marrow of the bones; and, what is still more important, eggs can be obtained for about three months only out of twelve. Eggs were largely consumed when in season, but for the above reason we cannot consider them to enter into the regular all-round diet of the year.

We will now turn to the vegetabilic food, which chiefly supplies the carbo-hydrates. No analysis being available, we will assume that fern root and the pith of the fern tree contain 5.5 per cent. of carbo-hydrates, the same as cabbage, though we can be pretty certain that even this is too high an estimate; therefore 1 kilogram fern root would contain 55 gram. of carbo-hydrates. Assuming their diet consisted of 1 kilo meat and 100 oysters (1), weighing in the aggregate 1,708 gram., and containing—

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(1) I take this number on account of the high percentage of carbo-hydrates the oyster contains.

	Gram.
Water	1,360
Protein	247
Fat	43
Carbo-hydrates	26
Salts.	30

a deficiency of 378 gram. of carbo-hydrates, omitting the fats (1), had to be made good by eating vegetables. If this were made good by eating cabbage, onions, or truffle, it would require in round figures—

Cabbage, 7 kilogram (2)=15½lb.
Onions, 3½ kilogram=7.7lb.
Truffles, 2 1-3 kilogram=5.0lb.

Taking even the most exaggerated view of the food value of fern root or fern pith, it would require 7 kilogram, or 15½lb. of this stuff, to supply the required quantity of carbo hydrates. No human being could digest such a quantity of vegetabilic matter, even if it did not contain such an enormous mass of wood fibres as fern roots do. Supposing they had, however, always an ample supply of Mylitta australis (the native bread), it would still require 2 1-3rd kilo=5.0lb., to produce the sufficient quantity of carbo hydrates, which would, by the way, contain 1,848 gram. of undigestible wood fibre.

The daily diet of the Tasmanians would therefore be approximately—

Meat, 1 to 2 kilo.
Oysters, 354 to 708 gram.
Fern tree root and other vegetables, 2 1-3rd to 7 kilo.

If we were to take the most favourable mixture, the total quantity of food consumed would be—

Meat, 1,000 gram.
Oysters, 708 gram.
Native bread, 2,333 gram.
} 4,141 gram.

If no native bread be available and fern root had to be consumed, the total quantity would be 8,679 gram.

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(1) Deficiency in fat could always be made good by a supply of eggs or a small quantity of marrow.

(2) More correctly 6.871 kilogram.

I have pointed out above that too large a quantity of shell fish could not possibly be consumed, on account of the limited supply. I therefore think that 100 oysters per day are too high an estimate, and that the deficiency had to be made good by the consumption of meat.

We will therefore assume the diet consisted of—

Meat, 2,000 gram.
Oysters, 354 gram. } 4,687 gram.
Native bread, 2,333 gram.

This quantity would be increased by 4,667 gram. up to a total of 9,358 gram. if the vegetables consisted of fern tree only, because more than 7,000 gram. would be required of this stuff.

We have therefore the following total weight of the food consumed daily per head:—

(a) If the carbo-hydrates were chiefly supplied by the consumption of fungi—min. 4,141 gram.=9lb. max. 4,687 gram.=10lb.

(b) If the carbo-hydrates were chiefly supplied by the consumption of fern roots—min. 8,679 gram.=19lb. max. 9,354 gram.=20lb.

It may be questioned whether a human stomach could digest such enormous quantities of food, in particular the large vegetabilic portion. It is much more certain that the Aborigines did not consume anything near the quantity of vegetabilic food theoretically required.

It is therefore certain that their diet was considerably in excess of protein and greatly deficient in carbo-hydrates. There was no possible way of making good the latter deficiency, and this accounts for their voracity. They were bound to consume enormous quantities of meat and shell fish in order to get even a small supply of carbo-hydrates. They attempted to add to this by eating certain vegetables, but the percentage of carbo-hydrates in them was so small that it did not assist materially unless enormous quantities, which no human being could digest, were consumed. It is pathetic to think that the whole existence of this race was a permanent struggle to satisfy the craving of the body for carbo-hydrates, but that they were never able to provide a sufficient supply.

The above investigations have solved that problem which so greatly puzzled the early explorers and colonists, namely, the voracity of the Aborigines on one side, and their hunger for bread, flour, or potatoes on the other. Dixon says:—"As their subsistence was precarious, their gluttony was great." Davies explains their voracity to a certain extent as Ling Roth thinks:—"They were often a long time without food, and then ate it in large quantities. . . . The enormous quantity of food which they are capable of eating, when they have an opportunity, would scarcely be credited. A native woman, at the settlement at Flinders Island, was one day watched by the officers, and seen to eat between fifty and sixty eggs of the 'sooty petrel' (Procelearia spec.), (1) besides a double allowance of bread. These eggs exceed those of a duck in size."

We now know that it was not lack of food that made them voracious, but its composition, which was unsuitable to sustain life if eaten in small quantities only.

We also understand now why the Aborigines were so particularly fond of bread, flour, and potatoes. One authority (O'Connor) goes in that respect as far as to say:—"The chief thing they want is bread, and they prefer getting a sack of flour by robbing a hut than to hunting opossums." All these articles of food are those that contain the carbo-hydrates, and by being particularly fond of them the Aborigines simply satisfied the unconscious craving of their body after non-nitrogenous, in particular carbo hydraceous food.

There is also another aspect of their essentially nitrogenous diet: All proteid foods are "tissue builders" or "flesh formers," while the non-nitrogenous group—the "respiratory or calorificient food"—has the function in it to furnish fuel in order to maintain animal heat. The great deficiency of the carbo-hydrates in the diet of the Tasmanians made it therefore extremely difficult for them to maintain the animal heat, and it is probable that sufficient temperature was only maintained at the expense of the muscular tissue. If this be so, there was a great waste of bodily strength, notwithstanding the enormous quantities of food they consumed, and this again must have weakened their bodies to such an extent that they easily succumbed to any disease. The excessive protein diet did therefore not benefit the race, though it must have lasted for generations; in fact, though a tissue-builder, the protein diet made the race as a whole weaker. It is also more than probable that the insufficient quantity of fuel, which made it extremely difficult to maintain the required temperature, paralysed the activity of the brain. During my studies I have dwelt over and over again on the absolute lack of inventive genius that was displayed by the Aborigines (1). If my theory is correct—if the sluggishness of their brain is the result of the lack of carbo-hydraceous food and the excess of protein—quite a new light is thrown on the evolution of the human race. As I have shown elsewhere, the archaeolithic Tasmanians must have branched off before the Strepyian stage set in. Is it possible that the great change that came over the human race of that period is due to an increased consumption of carbo-hydrates? In fact, that the protein diet of the Mesvinien was superseded by a diet in which nitrogenous and non-nitrogenous food was more suitably mixed, resulting in an increased heat of the blood, which in its turn stimulated the brain. The greater activity of the brain led to those inventions which the Tasmanian race never could make, but which revolutionised the life of human beings, that had been stagnant for millions of years? Is it probable that the Cro-Magnon race first adopted this new diet, and thereby gained that predominance which enabled it to wipe out the Neandertal race, of which the Tasmanians are only a branch? If my theory is correct, it is a great pity that we have no measurements of the body temperature of the Tasmanians, because it may perhaps have been somewhat lower than that of the Europeans.

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(1) Now called Puffius tenuirostris.

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(1) A peculiar group of tronattas, Pap. and Proceed. Royal Soc. of Tasmania, 1909. See also Noetling Studies ueber die Technik der tasmanischen tronatta, Archiv. f., Anthropologie Neue Folge Bd. viii., heft 3, 1909, pag. 197.

ADDITIONS TO THE CATALOGUE OF THE MARINE SHELLS OF TASMANIA.

By W. L. May.

(Read August 8th, 1910.)

In the Proceedings of this Society for 1908 I published a list of additional species, and since that date a considerable number of new forms have come under my notice, which it is the object of this paper to place on record.

The greater number of the following species were obtained during the Easter camp-out of the Tasmanian Field Naturalists' Club at Freycinet Peninsula, in March, 1910.

The s.s. Koonookarra, Captain R. Holyman, had been chartered by the Club, and was available for dredging, much of the success of the operations being due to the ability and active interest of the genial skipper. I had provided suitable dredges and 200 fathoms of wire rope, and on the two days (March 26 and 27), assisted by several interested friends, I dredged in Geography Strait and due east from there in 15, 40, 60, and 80 fathoms, the greatest depth being some ten miles off the coast. The nature of the bottom was very similar to that off Cape Pillar, explored by Mr. C. Hedley and myself in 1907, but not quite so hard, and there is probably considerably less current. Broken up polyzoa was very abundant. As was to be expected, many of the same species occurred which were taken off Cape Pillar in 100 fathoms; but, partly owing to shallower water being explored, and to the station being some sixty miles further north, many new species were taken, and also several most southern records of known Tasmanian shells, previously only known from Bass Strait.

These researches go to show more than ever the wide distribution of species on our Australian Continental shelf. Several recently described from deep water off both Sydney and Adelaide were here taken.

Besides the record of species new to our list I include others which, although recorded, have hitherto been extremely rare or of doubtful occurrence—in the latter case confirming the previous record. Altogether over 50 species are here added to our list.

It is my intention to place as complete a series as possible of these new shells in the Tasmanian Museum collection.

In addition to the species here listed, I have a number that appear new to science, some of which I hope to describe at a later period in these Proceedings.

I have to thank my friends, Mr. C. Hedley (of Sydney Museum), and Dr. Verco (of Adelaide) for kind help in identification

LIST OF SPECIES, WITH NOTES.

Sepia braggi, Verco; T.R.S., S.A., 1907. Specimens are in the Tasmanian Museum collection wrongly named S. elongata D'Orb, on which authority it was included by Tate and May in their Revised Census. I also possess a Tasmanian specimen.

Trophon recurvatus, Verco; T.R.S., S.A., 1909. Several examples in 80 fathoms off Schouten Island; also off Cape Pillar in 100 fathoms.

Fascinus typicus, Hedley; Mem. Aus. Mus. IV. Several adult specimens in 40 fathoms off Schouten Island; previously only known here by a single immature specimen.

Mitra bellapicta, Verco; T.R.S., S.A., 1909. Frederick Henry Bay, a few specimens taken from kelp roots washed ashore from deep water.

Mitra retrocurvata, Veco; op. cit. A number were taken off Cape Pillar in 100 fathoms. They vary somewhat from the type, and the same varieties also occur in South Australia.

Terebra lauretanæ, Tenison-Woods; P.L.S., N.S.W., 1878. A single adult specimen from 40 fathoms off Schouten Island adds this fine species to our list. It has considerable resemblance to some tropical forms.

Hedley (Rec. Aus. Mus., Vol. VI.) has recently figured the species from a specimen taken in 300 fathoms off Sydney.

Drillia lacteola, Verco; T.R.S., S.A., 1909. Numerous examples in 80 fathoms off Schouten Island, also plentiful off Cape Pillar in 100 fathoms. The commonest species of its family in the deeper water of our Continental shelf.

Drillia saxea, Sowerby; P. Mal. Soc., 1896. A number were taken in 100 fathoms off Cape Pillar, and several in 40 fathoms off Schouten Island.

Drillia tricarinata, Tenison-Woods; P.L.S., N.S.W., 1878. Taken in 40, 60, and 80 fathoms off Schouten Island; most numerous in the shallower water. It shows here the same variation recorded by Verco (T.R.S., S.A., 1909).

Mangilia connectens, Sowerby; Pro. Mal. Soc., 1896. A common shell in D'Entrecasteaux Channel, but hitherto unidentified.

Mangilia fallaciosa, Sowerby; P.M.S., 1896 (Daphnella). Many specimens in fine condition were taken in 100 fathoms off Cape Pillar.

Daphnella bathentoma, Verco; T.R.S., S.A., 1909. Two specimens from 100 fathoms off Cape Pillar.

Daphnella lamellosa, Sowerby; P. Mal. Soc., 1896 (Clathurella). Several examples of this beautiful little shell were taken in 40 fathoms off Schouten Island; also fragments in 100 fathoms off Cape Pillar.

Daphnella triseriata, Verco; T.R.S., S.A., 1909. Several specimens from 40 fathoms off Schouten Island.

Mitromorpha angusta, Verco; T.R.S., S.A., 1909. Numerous in 100 fathoms off Cape Pillar.

Leucosyrinx recta, Hedley; Mem. Aus. Mus., IV. Three examples from 80 fathoms off Schouten Island. Add a genus and species to our list.

Larina (?) turbinata, Gat. and Gab.; P.R.S., Vic., 1909. Three specimens (the largest living) occurred in 40 fathoms off Schouten Island. It was previously recorded by the authors from our North Coast. This shell probably requires a new genus for its reception.

Scala invalida, Verco; T.R.S., S.A., 1906. Several specimens from 100 fathoms off Cape Pillar.

Stylifer brazieri, Angas; P.Z.S., 1877. I have a specimen taken by the trawler "Endeavour" in about 30 fathoms, Storm Bay, 1909.

Lippistes gracilenta, Brazier; P.L.S., N.S.W., 1877. One specimen in 40 fathoms off Schouten Island adds a genus and a most interesting species to our list. The type was from Darnley Island, Torres Straits, and this capture gives it a surprisingly long range in latitude.

Lippistes meridionalis, Verco; T.R.S., S.A., 1906. Two specimens in 80 fathoms off Schouten Island.

Bittium turritelliformis, Angas; P.Z.S., 1877. One indiviual from 40 fathoms off Schouten Island.

Triphora cana, Verco; T.R.S., S.A., 1909. One perfect specimen from Frederick Henry Bay, taken many years since. Another immature specimen from 40 fathoms off Schouten Island.

Triphora epallaxa, Verco; op. cit. Two examples from 80 fathoms off Schouten Island; a very distinct form, and remarkable in the genus as being dextral.

Triphora albovittata, Hedley; P.L.S., N.S.W., 1902. I have a specimen collected by Dr. Verco on our northern coast.

Triphora cinerea, Hedley; op. cit. Several immature specimens collected on the North Coast.

Triphora spina, Verco; op. cit. Three specimens from 40 fathoms off Schouten Island; a very elongated form.

Triphora disjuncta, Verco; op. cit. Several specimens from 80 fathoms off Schouten Island; probably a variety of T. tasmanica (Ten.-Woods). Another variety, viz., lilacina, Verco, op. cit., was taken in 10 fathoms off Pilot Station, d'Entrecasteaux Channel.

Rissoa (Scrobs) jacksoni, Brazier; P.L.S., N.S.W., 1895. Numerous in 10 fathoms off Pilot Station; it is very minute.

Rissoa filocincta, Hedley; Rec. Aus. Mus., Vol. VI. Taken in 40 and 80 fathoms off Schouten Island; several specimens at each station.

Cyclostrema jaffaensis, Verco; T.R.S., S.A., 1909. One perfect shell from 80 fathoms off Schouten Island adds this fine and peculiar form to our list. The type was from 90 fathoms off Cape Jaffa, South Australia.

Cyclostrema denselaminata, Verco; T.R.S., S.A., 1907. Several from various stations off Schouten Island. It varies considerably, some examples being fairly typical.

Gena terminalis, Verco; T.R.S., S.A., 1905. One example from 40 fathoms off Schouten Island.

Emarginuia superba, Hedley; Rec. Aus. Mus., Vol. VI. Taken in 40 fathoms off Schouten Island. Several specimens, the largest being 27 mill. in length by 21 mill. broad, and is thus larger than the type which was taken in 300 fathoms off Sydney. This fine species, one of the largest known, was included in the Cape Pillar mollusca (P.L.S., N.S.W., 1908). Owing to a mistaken identification, the species then taken for it, is not uncommon in deep water, and is so far unidentified, having a strong resemblance to E. tenuicostata, Sowerby.

Puncturella demissa, Hedley; Rec. A. M., 1904. Several specimens from 15 fathoms Geography Strait. This species ranges to New Zealand.

Lepidopluerus inquinatus, Reeve, Conch. Icon. The type in British Museum is assigned to Tasmania. It was not, so far as I know, in any local collection until taken recently by myself in 10 fathoms off Pilot Station, where about a dozen examples occurred.

Chiton quoyi, Desh., An. Sans. Vert., VII. Taken under stones at Bellerive Bluff, February 12th, 1910. This New Zealand species was included by Tenison-Woods in his Census, under its synonym of C. glaucus (Gray), but without giving habitat or any remarks, and for want of confirmation it was omitted by Tate and May in their revision. It is now satisfactorily reinstated. It is curious that its habitat should be so restricted as it appears to be. Such a conspicuous form would not easily be overlooked; possibly it has been introduced on imported New Zealand oysters.

Actæon retusus, Verco; T.R.S., S.A., 1907. One example from 40 fathoms off Schouten Island.

Cylichna protumeda, Hedley; Mem. A. M., 1903, Var. Numerous in 40 fathoms off Schouten Island. These shells have exactly the form of the type, but are quite smooth, showing none of the fine revolving sculpture which is typical.

Pugnus parvus, Hedley; Rec. A. M., 1896. Five specimens from 40 and 80 fathoms off Schouten Island add this interesting little genus and species to our list. It has a wide geographical range.

Cavolina inflexa, Lesueur, 1813. One specimen from 80 fathoms off Schouten Island adds another species to our recorded list of Pteropods.

Atlanta, sp. indet. One example of this genus was taken in 80 fathoms off Schouten Island, but is too imperfect for specific determination. This is the first record for Tasmania of the class Heteropoda.

Cuspidaria exarata, Verco; T.R.S., S.A., 1908. A pair and several valves from 40 fathoms off Schouten Island. This is an unusually large form, one of the valves measuring over 30 mill. in length.

Ectorisma granulata, Tate; T.R.S., S.A., 1892. Two valves (a pair) taken by the trawler Endeavour in Storm Bay in about 30 fathoms. Two separate valves in 40 fathoms off Schouten Island. Mr. Hedley (Rec. A. M., VI.), says this is a Poromya, and the specific name is preoccupied in the genus, but it may possibly be identical with P. lævis (Smith), Challenger report.

Thracia myodoroides, Smith, Challenger report, 1885. One valve in 40 fathoms off Schouten Island.

Myodora pandoræformis, Stutchbury. This species has long been on our list, but seems to have been unknown to local collectors. Many separate valves were taken in 40 fathoms off Schouten Island.

Dosinia histrio, Gmel., var. One valve occurred in 40 fathoms off Schouten Island.

Cardium pulchellum, Reeve. A yellow variety; was numerous in 40 fathoms off Schouten Island amongst hundreds of specimens of the usual colour. This is one of the most plentiful and widely distributed species in our waters, being commonly dredged in all depths from 10 to 100 fathoms.

Lucina crassilirata, Tate, 1886. A number of living examples were taken in Geography Strait in 15 fathoms; small dead valves in 40 fathoms three miles seaward.

Rochefortia lactea, Hedley; Mem. Aus. Mus., IV. Geography Strait, 15 fathoms; several specimens.

Crassatellites aurora, Angas; P.Z.S., 1863. Several valves occurred in both 40 and 80 fathoms off Schouten Island. This is the most southern record. The type was from Banks Strait.

Cardita raouli, Angas; P.Z.S., 1872. Several valves of this very distinct species were taken in 40 fathoms off Schouten Island. Another species on our list which appears to have been unknown to local workers.

Cardita delicata, Verco; T.R.S., S.A., 1908. Numerous valves in 100 fathoms off Cape Pillar.

Carditella exulata, Smith; Challenger report. Several examples taken at various times in Frederick Henry Bay; usually from kelp roots.

Nuculina ((cyrilla) concentrica, Verco; T.R.S., S.A., 1907. Several living specimens and valves add an interesting genus and species to our list; from 40 fathoms off Schouten Island.

Leda ensicula, Angas, P.Z.S., 1877. Numerous living and dead in 40 fathoms off Schouten Island. This species in external appearance is exactly similar to Leda lefroyi, Beddome, which is found in d'Entrecasteaux Channel, but the hinge teeth are very different.

Leda miliacea, Hedley; Mem. Aus. Mus., IV. Several single valves of this small but distinct species were taken in 80 fathoms off Schouten Island.

Limopsis eucosmus, Verco; T.R.S., S.A., 1907. Two valves occurred in 80 fathoms off Schouten Island.

Trigonia margaretacea, Lamk.; Var. acuticostata, McCoy. Some perfect specimens and numerous valves were taken in 40 fathoms off Schouten Island. The ribs in this variety are closely set with short spines, giving it a very distinct appearance.

Modiola linea, Hedley; Rec. Aus. Mus., VI. Several living and valves from 40 fathoms off Schouten Island. The species is very small, and very distinct from our other forms, but most nearly approaching M. arborescens.

Philobrya tatei, Hedley; Rec. Aus. Mus., 1901. A number of single valves occurred in 80 fathoms off Schouten Island. Identified by the author.

Philobrya pectinata, Hedley; Mem. Aus. Mus., IV. Also numerous as single valves in 40 fathoms off Schouten Island.

Cyclopecten favus, Hedley; op. cit. Several valves were taken in 40 fathoms off Schouten Island.

THE DISTRIBUTION OF AUSTRALIAN LAND BIRDS (1). (PL. VII.)

By Robert Hall, C.M.Z.S., Col. M.B.O.U.

(Read 8th August, 1910.)

Previously (2) I indicated the Geographical Distribution of Passerine Birds in Australia, and what appeared to me to be the directions of their expansion over the Continent.

The numerals (1 to 9) were placed upon those portions of the map which I considered to be the natural avifaunal areas. Had I then realised the order in which they spread over the Continent I should have placed 1 where 8 is, 2 where 1 is, and 8 where 7 is now, and so on, for convenience sake.

At that time, when dealing with the Passeres alone, the area 2 was strongest in species and area 3 in genera.

I expressed the opinion that the Passerine birds of area 2 had their origin in the old Papuan sub-region, and that the greater part of the remaining Passerine birds of Australia was derived from this area, travelling along three routes—from the N.E. to the W., from the N.E. to the S.E., and from the S.E. to the S.W. of the Continent (3). The present-day parrots do not lend themselves to any of these lines of expansion, a recent evolutionary centre appearing to have been in area 7. Taking for example the large genus, Neophema, we find the line 2, 1, 8 unrepresented, and with only a single species in area 9, as the tip of the western wing.

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(1) Not including the migratory Charadriformes and the swimming birds, and referring only to the Australian continent and Tasmania.

(2) Key, Bds. Austr. (1906).

(3) Pl. vii., indicating lines of expansion.

To strengthen that opinion, I have tabulated the whole of the Australian birds, and find the same comparison is equally strong with every area (4).

From the Papuan sub-region almost the whole of the present bird fauna appear to have had their origin.

Approximately 200 species of the 350 species of area 2 gradually emigrated from area 2 into area 1, while 170 species of the 250 of area 1 gradually emigrated into area 8, and gave it the greater part of its present avifauna. A census of the avifauna of Northern Australia shows that the greater part of the areas 2, 1, 8 is the same with regard to species, being numerically the strongest in species and genera in area 2, getting less in number as we travel from the Gulf country to the Fitzroy River country (area 8). That is the positive evidence. The negative is seen in the comparisons of the area 2 with 3 and 4, 1 with 7, 8 with 9.

In comparing areas 8 and 9 (1) I find area 8 has approximately 200 species, and area 9 also has 200 species. Common to both are 100 species, leaving 100 species in 8 and 100 species in 9 that do not encroach on each other's territory. The distribution of the species of this census shows that the 100 species of 8 are derived from 1, and the 100 species of 9 are mostly derived from 6 and 7. The reason surely lies with the desert between 8 and 9, and the desert of area 7, acting as a barrier to expansion. This does not exclude the migration of species between 8 and 9, which are a part of the 100 species common to both.

Area 8 is conspicuously made up of the genera of the north, derived from area 2, while area 9 is as prominently composed of the genera of the south, derived from area 6 and 4. This is exemplified in the Ploceidae of the north and in Neophema of the south.

Both areas 8 and 9 have scarcely any genera not represented in 2 and 4 respectively, while numerically they are very much weaker through the wave of emigration decreasing as it went westward.

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(4) The distribution of the genera and species is where they more commonly occur, and certainly not as "accidentals;" further, sub-species recorded as such, and certain sub-species recently recorded as species, are mostly not included in the Tables. Gregory Mathews' Hand List has been referred to.

(1) See Table III.

In comparing the species of area 1 and 7 it is to be seen (1) that the birds of area 1 are derived from area 2, while the birds of area 7 are derived from 2, 3, 4, and 6.

The mass of the species that are found in areas 2, 3, 6, and 7 conjointly are not included in areas 8 and 1. It is noticeable in the census I prepared to get these data that areas 7 and 6 are strongly connected by common species. I take it that the Darling River and the Lake Eyre Basin, by means of their water ways, have been important feeders of the eastern half of area 7.

If the Cooper and Diamintina at one time flowed into the Murray Basin, this was certainly a good opportunity to reach Central Australia from the south-east. Since that period Central Australia had its Lake Eyre subsidence—a period of good food for the birds. Then followed the salting of the central lakes, and a period of great stress for all the animals. It is probable that the bird population was so reduced that a second series then worked up from area 6, like those of that area.

The Great Valley of South Australia in a series of suitable seasons would offer facility for birds of area 6 to emigrate into the valleys of the Cooper and Diamintina.

That the species of area 7, for the most part, came from areas 6 and 3, and for the least part from areas 2 and 1, appears to be so. The watershed between Hughenden and Cloncurry may have had some small barrier effect in the north.

In comparing areas 2 and 3 it will be seen that a strong affinity exists. In area 2 there are 342 species, in area 3 297 species. Excepting a few species these 297 are found in area 2. The further south this emigration course extends the weaker it becomes in species. The tables show the decreasing values of 2, 3, 4, and 5, indicating the area 2 to be by far the strongest in species; then 3, 4, and 5, each in order getting weaker than the last.

Between the Hawkesbury and Richmond Rivers (areas 3 and 4) we get a change of vegetation that affects the avifauna—a plant-zone barrier.

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(1) See Tables I. and III.

Between areas 4 and 5 we have a water barrier. As Tasmania is considered to have been connected with Victoria in post-glacial times, it would appear as if such forms as Menura, Psophodes, and Sphenura would not enter the higher latitudes when they had the opportunity. This is so with a large portion of the birds of area 4. If they then existed in area 4, surely a larger proportion, including Menura, should be showing in area 5. Possibly Menura got further south, in area 4, as Sarcophilus and Thylacinus died out, and was not far enough south when the subsidence of Bass Strait occurred.

At the southernmost end (area 5) of this eastern course of emigration there are known to us only two genera peculiar to it, and one of them ill-defined (Acanthornis). Its close allies (Acanthiza and Sericornis) (1) are of a family that has mostly evolved its numerous species in Southern Australia, these two genera being scarcely represented in areas 2, 1, 8, though represented in New Guinea.

The western line of emigration, beginning at area 4 and continuing through 6 to 9, is one of much interest.

Area 9 has derived its avifauna from areas 7 and 6. Area 6 has derived a large portion from area 4. Area 7, adjacent to 6, has locally evolved a part of its species, and sent a portion of it to area 6.

Thus area 6 is larger in number of species than area 4, pointing to the favourable conditions for species making by the already mentioned waterways of the Eyrean sub-region.

That area 7 appears to derive its genera and most of its species from areas 3 and 6 may be deduced from the data of geographical distribution in the faunal subregions.

An examination of these data will show that it is, least of all, in harmony with the areas 8 and 1. It is not easy to prove that area 7 was not populated by immigrants from area 2, but it is easier to attempt to prove that it was in the greater part populated from areas 4 and 6.

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(1) Strangely enough the two closest offshoots of Sericornis in Australia are at the opposite poles of its eastern range, viz., Oreoscopus in area 2 and Acanthornis in area 5. A comparison of the pterylosis of these three genera would be interesting.

From the same data I find that area 8 received its present genera and most of its species from area 1, which in its earlier turn received its forms from area 2. That is the northerly line of westerly emigration.

In considering the distribution of the present races of the genera, it would appear very much as if Western Australia had drawn its avifauna from Eastern Australia. Lacustroica (1) is the only genus peculiar to 9, while area 8 has only one genus peculiar to it. Of Lacustroica there are no external characters that lead one to see in it a remaining form of an old fauna, and there is nothing on the whole face of the avifauna of Western Australia to indicate a western origin.

Neither does the indication point to an Eyrean origin in so far as genera are concerned. There is in area 7 not a genus peculiar to it, all being eastern and south-eastern genera.

What the avifauna of 7 was like when the Thylacine wandered about Lake Eyre I am not prepared to say, except that I believe it originally came from the north-east of the continent.

It is the "dead heart" of Australia that has passed on to area 9 the present fauna, assisted by area 6, portions of which evidently have passed through the same troublesome period.

The inferences drawn show the gradual blending of the areas 1—9, directly or indirectly, into area 2, or less remotely into areas 2 and 3 combined.

We know that many of the Australian passerine genera are also represented in other zoological regions—the Zosteropidæ, Dicæidæ, etc. (2).

A knowledge of the expansion of their areas would be interesting. Zosterops, from an Australian point of view, has four much deflected radii from the Papuan sub-region—(a) the northern coast of Australia; (b) the eastern coast of Australia, altering its course in area 4 to pass into area 9; (c) Japan via China; (d) South Africa via the horn of Africa and India. The distribution of each radius, broadly speaking, is a continental fringe.

(1) Emu, vol. ix., pl. 15 (1910).
(2) A.A.A.Sc., Brisbane (1909), pl. p. 748.

RELATIONSHIP OF THE AREAS.

Considering first the area 2, we find four associations—New Guinea on the north, area 3 to the south, area 1 westward, and area 7 south-west. In comparing the birds of New Guinea with those of York Peninsula, we find that the birds of the Peninsula are more closely allied to those of areas 1, 3, 7 than those of New Guinea are to them. Area 2 and New Guinea have so many genera in common that Bowdler Sharpe united them as the Papuan sub-region. The Paradisea and Cassowary connect them (1). Area 3 is found by species to be more closely in association with area 2 than New Guinea is, and less closely as far as peculiar genera are concerned. There are at least five (2) conspicuous genera in area 2 that are entirely absent from area 3. Other than these, there are at least five (3) conspicuous genera in area 2 absent from area 1; and at least five (4) conspicuous genera in 2 absent from 7.

To indicate the strength of age of area 2 it may be seen that it has twelve well marked genera within it and peculiar to it as far as Australia is concerned. There are six more genera in area 3 than in area 2, but, excepting one, they are not peculiar to it.

A suggestion, in explanation, is offered when referring to area 3. The table III. shows 342 species as found in area 2.

GENERA IN AREA 2 NOT KNOWN IN AREA 3 (5).

(21 Genera=12¼ Per Cent. of the 172 Genera.)

Gypoictinia	1, 2, 6, 9
Craspedophora	2
Phonygama	2

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(1) As well as Graucalus (Coracina), Grallina, Pinarolestes, Microeca, Malurus, Gerygone, Drymaoedus, Cracticus, Eopsaltria, Cinclosoma, Climacteris, Pachycephala, Podargus.

(2) Craspedophora, Prionodura, Heteromyias, Arses, Calornis.

(3) Ptilorhis, Geocichla, Acanthiza, Meliphaga, Meliornis (all present in area 3).

(4) Cinnyris, Phonygama; Craspedophora, Calornis, and Ptilorhis.

(5) Most closely related to New Guinea genera.

Prionodura	2
Heteromyias	2
Machærorhynchus	2
Arses	1, 2
Scenopæetes	2
Oreoscopus	2
Cyrtostomus	2
Lamprocorax	2
Neochmia	1, 2, 8
Pitta	1, 2, 8
Syma	1, 2
Tanysiptera	2
Microglossus	2
Myristicivora	1, 2
Megapodius	1, 2
Rallina	2
Eulabeornis	1, 2, 8
Poliolimnas	1, 2

Area 3 is more closely allied to area 2 than it is to area 4, one reason showing in that it has 297 species to compare with 342 of area 2 (2), while it can compare with only 222 in area 4, and 243 in area 7.

A stronger reason of its closer affinity with area 2 is that the great bulk of its genera are allied to those of Papua.

Certain genera (2) of area 3 present in 2 and absent in 4 are examples.

Still there are forms (3) that appear to indicate other than a direct Papuan origin, unless the generic links have been weakened and the species rapidly evolved under the different conditions of Southern Australia. In the concluding part of this paper it is considered they have been evolved under the special Australian conditions.

The greater number of Passerine genera of area 3 over area 2 (Table I.=7 per cent.) may be marked of doubtful importance when such forms as Myzantha, Aidemosyne, Cinclosoma, and Pterypodocys are considered. Table II. shows area 2 to have 95 genera and area 3 to have 90 genera; while Table III. shows area 2 to have 172 genera and area 3 to have 173 genera.

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(2) Bathilda, Poephila, Pseudogerygone, Poecilodryas, and Plectrorhynchus.

(3) Sericornis, Acanthiza, Ploceidae, Psittaciformes.

The following table shows the genera of area 3 not found in area 2:—

GENERA IN AREA 3 NOT KNOWN IN AREA 2 (1).

(22 Genera=12½ Per Cent. of the 173 Genera.)

Hylacola	3, 4, 6, 7, 9
Sericulus	3, 4
Pterypodocys	3, 6, 7, 9
Stipiturus	3, 4, 5, 6, 8, 9
Sphenura	3, 4, 6, 9
Origma	3, 4
Chthonicola	3, 4, 6
Cinclosoma	3 4, 5, 6, 7, 8, 9
Gymnorhina	3, 4, 5, 6, 7, (8), 9
Acanthorhynchus	3, 4, 5, 6
Myzantha	1, 3, 4, 5, 6, 7, 8, 9,
Annelobia	3, 4, 5, 6, 9
Staganopleura	3, 4, 6, 7
Zonaeginthus	3, 4, 5, 6, 7, 9
Aidemosyne	3, 7
Atrichornis	3, (4), 9
Menura	3, 4
Callocephalon	3, 4, 5
Neophema	3, 4, 5, 6, 7, 9
Euphema	3, 4, 5, 6, 7
Pezoporus	3, 4, 5, 6, 9

There are in area 3 certain genera absent in 2 while present in area 4. It is these southern and central genera coming into 3 from areas 4 and 7 that make the genera of area 3 numerically greater than that of area 2. But it is only to increase the number of genera, and not disturb the northern origin. Certain of the genera (2) in-

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( ) Not having a northern distribution (8, 1, 2), with exceptions.

(2) Atrichia, Meliornis, Aeluroedus, Piezorhynchus, and Eopsaltria.

dicating this area as a well timbered and moist one, do not pass into area 7.

Area 3 contains 297 species, while area 7 contains 243 species, the bulk of which are derived from areas 3 and 6. The genus Sericulus is the only one peculiar to the area.

The Bassian sub-region in its low latitudes gradually loses the tropical and sub-tropical forms carried on with the stream from 3 into the northern part of area 4. Area 4 has its northern boundary between the Clarence and the Hawkesbury Rivers. There the northern rich scrubs cease, as do the fruit pigeons.

It has 222 species, which are more like those of area 3 than any other area excepting 5, which is simply a severed portion of 4, having an insular fauna, very slightly modified.

Of the 139 genera in area 4, four (1) are not to be found in area 3; twenty-two (2) in area 6; and forty (3) in area 5. This tends to show how the journey south gradually loses from the list of each area a growing number of genera. Twenty-five (4) are not to be found in area 7. Very few genera are added to area 4 from areas 7 and 6, and not any from area 5 (5), because there is no available continuous area from which to draw. The genus peculiar to area 4 is Pycnoptilus.

Area 5 but for Bass Strait would be the southern faunal end of area 4. The insular area is evolving species, though with one exception making no genera different from those in area 4.

Area 5 has 114 species. Of these, approximately, 100 are contained in the 222 species of area 4; thus about 100 have been lost to this last part of the course of the southern emigration. The subsidence that formed Bass Strait has not changed sufficiently the conditions of area 5 to make a specially noticeable change in its fauna.

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(1) Calamanthus, Pycnoptilus, Monarcha.

(2) e.g., Atrichia, Psophodes, Oriolus.

(3) e.g., Ptilonorhynchus, Piezorhynchus, Aegintha.

(4) e.g., Menura, Pycnoptilus, Sphenura.

(5) Tribonyx is accidental.

One genus absent from 6 that is present in areas 4 and 5 is Cisticola. Cisticola in emigrating from 4 to 5 did not get further south than the Bass Strait Islands.

Acanthornis is the only passerine genus peculiar to area 5, while Tribonyx is the second peculiar genus.

Area 6 with its 239 species appears to have been constructed from areas 4 and 7. It would seem as if it had drawn largely from area 4, then passed many of the species on to area 7, differentiated certain of them there, and had returned to area 6 a part of each of those species. By this means it could make a large list of species. The hawks and parrots so largely represented in area 7 are mostly common to area 6. These are barely represented in area 4, thus making a distinct difference by two important orders between areas 6 and 4.

Xerophila, Amytornis, Oreoica, Drymædus, and Entomophila are not found in area 4, being immigrants from area 7 to 6.

Eopsaltria, Meliornis, Acanthorhynchus, Pseudogerygone, and Chibia of area 6 are found in area 4, but not in area 7. All but Chibia continue their westerly course in area 9.

Origma, Menura, and Pycnoptilus, of area 4, do not find suitable country in area 6, and are absent from it.

This area is devoid of strong opposing characters when compared with area 7, but because of the forms that are passing through it and not through area 7, to area 9, it is sufficiently differentiated to be recognised as an avifaunal area. It is here that Lipoa and Menura almost meet—birds of the ultra-dry and ultra-moist country respectively.

Area 7 is the broadest—and the desert area. The relation of Passerine genera and species to the other areas is shown in Table I. It is seen how it is least of all in affinity with areas 8 and 1, and most of all with areas 6 and 3.

The generic relationship of area 7 with the other areas may be shown by stating the principal genera of 7 absent in the areas, as follows:—

Area 6.	Area 3.	Area 9.	Area 2.
Bathilda.......	Struthidea.....	Entomyza.....	Pteropodocys..
Emblema......	Amytornis.....	Meliphaga.....	Acanthochaera.
Aidemosyne....	Drymaedus......	Philemon......	Amytornis.....
Myiagra	Calamanthus...	Stagonopleura.	Calamanthus...
Gerygone......	Entomophila...	Aidemosyne...	Stagonopleura.

Area 4.	Area 1.	Area 8.
Chlamydodera..	Corcorax......	Sericornis.....
Aphelocephala..	Cinclosoma....	Hylacola......
Oreoica.......	Acanthiza......	Megalurus.....
Entomophila...	Falcunculus...	Pteropodocys..
Emblema......	Strepera.......	Strepera.......

The genera above as absent from area 6 have a northern and eastern distribution; those absent from area 3 have a dry country distribution (excepting certain of the Calamanthi); those absent from area 9 have an eastern distribution; those absent from area 2 have a southern and western distribution; those absent from area 4 have a distribution in districts of small rainfall; those absent from area 1 are genera with a southern distribution; while wanting in area 8 are Strepera and Megalurus, which are distributed all over the continent excepting the north-west; Hylacola and Pterypodocys not represented in Northern Australia; Sericornis and the other large and closely allied Acanthiza being scarcely, if at all, represented in North-west Australia.

Area 9 appears to have for its birds two places of origin—areas 7 and 6. The western plateau of Central Australia is continuous with that of the eastern portion of Western Australia. There is in fact no barrier across the whole of Southern Australia for those genera that can live in arid country.

In the south-west of area 9 there is a small area of country in which one may naturally be interested. It is isolated and separated from its like by about half of the continent. Its like is the south-east corner of Australia (area 4). Yet it has genera (1) that are found in area 4 and not in the intervening country.

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(1) Psophodes, Atrichornis, and Sphenura.

There is still the feeblest kind of bridge in the broad tract of southland between Eyre Peninsula and King George's Sound.

I think when the Diprotodon was being embedded in the pleistocene limestone the conditions were favourable to the passage of those genera now in the south-west, and consequently not favourable to their return. I have collected Diprotodon remains on the southern end of Eyre Peninsula. These are now in the Tasmanian Museum. The disturbances which formed the great valley of South Australia rather dislocated the western emigration course of the most southern birds from area 4.

According to Professor J. W. Gregory (1) this is of much later age than either the marine clays or desert sandstone of the central plains of area 7.

The Table I. shows ninety-nine species of Passerine birds found in area 9. Of these, two-thirds are to be found in area 7, as well as two-thirds in area 6, while only one-quarter of them is to be found in area 8. The same table shows sixty genera. Excepting four genera the whole of these are to be found in area 6, and the whole of the same in area 7, excepting seven genera, while in area 8 there are twenty genera absent. The effect of an intervening desert on a fauna that is not a desert fauna is clearly seen in these western areas.

Looking at the western line of emigration in the north, we find area 1 is the first western offshoot of the southern part of the old Papuan sub-region.

A reference to the relation of species with other areas has been made, as above. Generically the position is a similar one, there being only six of the fifty-four passerine genera absent from area 2. By the time the passerine genera of area 1 had populated area 8 no less than nineteen of these genera were found to be absent in area 8. About one-third of the passerine genera of area 1 is absent from area 7, as follows:—Poephila, Munia, Neochmia, Calornis, Eopsaltria, Monarcha, Piezorhynchus, Arses, Poecilodryas, Oriolus, Sphecotheres, and Chibia. Genera in area 1 other than passerine, and absent from area 7, are:—Alcyone, Syma, Centropus, Ptilopus, Columba, Myristicivora, Lopholæmus, Macropygia, Chalcophaps, Petrophassa, Eulabeornis, Poliolimnas, Hydralector.

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(1) "The Dead Heart of Australia," p. 241 (1909). See Year Book Commonwealth 1910, Geological Map.

To area 8 I have already referred with regard to its species. Of the order of Passeres (1)—45 genera 77 species—eleven genera and fifty species are not represented in area 9. Twenty-five per cent. of the passerine genera of area 8 are not known in area 9,, 11 per cent. of area 8 are not known in area 1, and 33 1-3rd per cent. of area 9 are not known in area 8. Although 75 per cent. of the genera of area 8 are recorded as found in area 9, it does not follow that they got into area 9 by means of area 8, but rather that they emigrated into area 9 by means of areas 6 and 7.

The generic contrasts of areas 8 and 9 are shown in the following two lists:—

GENERA OF AREA 8 NOT IN AREA 9.

PASSERES.

Pitta
Neochmia
Poephila
Bathilda
Munia
Philemon
Tropidorhynchus
Poecilodryas
Gerygone
Oriolus

OTHER ORDERS.

Eurystomus
Alcyone
Dacelo
Endynamis
Phasianus
Ptilosclera
Petrophassa
Geophaps
Lobivanellus
Eulabeornis

GENERA OF AREA 9 NOT IN AREA 8.

PASSERES.

Strepera
Gymnorhina (seen only in the southern part)
Falcunculus
Eopsaltria
Pterypodocys
Sericornis
Acanthiza (1 species)
Psophodes
Calamanthus
Aphelocephala
Acanthochaera
Acanthogenys
Annelobia
Acanthorhynchus
Zonaeginthus
Atrichornis

OTHER ORDERS.

Lipoa
Coturnix
Neophema
Spathopteris
Polytelis
Glossopsittacus
Lacustroica

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(1) Brit. Mus. Cat. Bds. (1877-1890).

The following tables give the distribution of certain genera and species:—

TABLE I.—PASSERES. (1)

Area … … …	8	1	2	3	4	5	6	7	9
Species … … …	94	120	190	153	121	55	117 (2)	126	99
Species absent in ..	1-20 7-37 9-50	2-44 7-84 8-65	3-82 1-109 7-121	2-53 4-47 7-71	3-28 6-52 7-66 5-90	4-14 6-29	4-53 9-61 7-24	6-29 9-46 3-49 4-68 2-69 8-92 1-96	6-37 6-37 8-72
Genera … … …	45	54	77	83	71	34	65	66	60
Genera absent in…	1-5 7-6 9-11	2-6 7-16 8-19	3-11 1-27 7-30	2-16 4-15 7-28	3-4 6-21 7-25 5-39	4-1 6-4	7-5 9-11 4-17	6-5 3-10 9-16 2-19 4-21 1-26 8-34	6-4 7-7 8-20

TABLE II.—ACCIPITRIFORMES, PSITTACIFORMES TURNICIFORMES, RALLIFORMES, COLUMBIFORMES, AND THE NON-MIGRATING CHARADRIFORMES.

Area … … …	8	1	2	3	4	5	6	7	9
Species … … …	107	124	152	144	101	59	122	117	106
Species absent in ..	1-14 7-37 9-23	2-11 8-28 7-55	3-31 1-44 7-67	2-18 4-47 7-48	3-8 6-12 7-26 5-36	4-2 6-5	7-19 4-36 9-37	6-13 3-28 2-36 9-37 4-46 1-50 8-52	6-17 7-25 8-27
Genera … … …	77	81	95	90	68	50	80	79	78
Genera absent in ..	1-8 9-17 7-18	2-4 8-8 7-19	3-12 1-24 7-34	2-6 7-23 4-25	3-4 6-5 7-12 5-17	4-1 6-2	9-9 7-10 4-16	6-5 9-9 3-11 2-13 8-15 1-19 4-22	6-3 7-3 8-10

(1) Brit. Mus. Cat. Bds. (1877-1890).

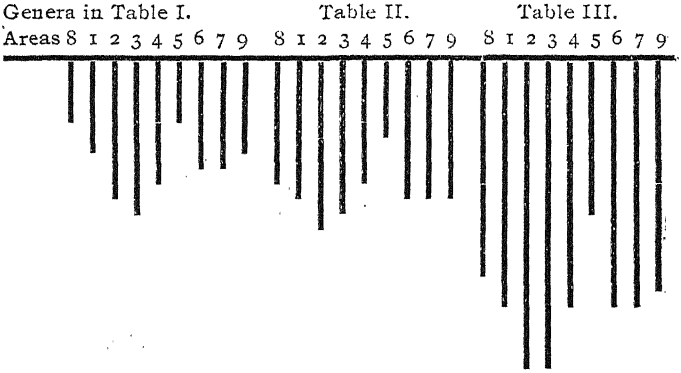
(2) Not taking into consideration certain doubtful insular species.

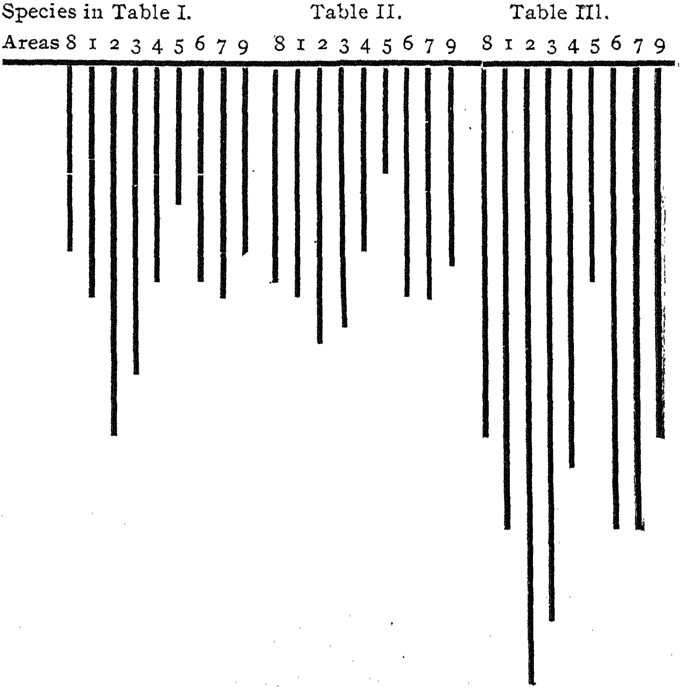
TABLE III.—LAND BIRDS OTHER THAN THE MIGRATING CHARADRIFORMS AND SWIMMING BIRDS (i.e.—Tables I. and II.)

Area	8	1	2	3	4	5	6	7	9
Species	201	244	342	297	222	114	239	243	205
Species absent in..	1-34 9-73 7-74	2-55 7-112 8-120	3-113 1-153 7-188	2-71 4-94 7-119	3-36 6-64 7-88 5-126	4-16 6-34	7-43 4-89 9-98	6-42 3-77 9-83 2-105 4-114 8-144 1-146	6-54 7-61 8-99
Genera	122	135	172	173	139	84	145	145	136
Genera absent in	1-13 7-24 9-28	2-10 8-27 7-35	3.21 1-51 7-64	2-22 4-40 7-51	3-8 6-26 7-37 5-56	4-2 6-6	7-15 9-20 4-33	6-10 3-21 9-25 2-32 4-43 1-45 8-49	6-7 7-10 8-30

The values of portions of the preceding tables are shown in the following comparative table of genera and species:—

TABLE OF RELATIVE VALUES.





In the distribution of the birds under review there are certain points of interest—

(a) The genera and species are numerically strongest in areas 2 and 3, those of area 2 not represented in area 3 being northern or Papuan forms, while those of area 3 not in area 2 being mostly southern or central forms (probably evolved in Australia), approximate 12 per cent. of the whole in each case.

That the list of the genera of either area 2 or 3 is 16 per cent. stronger than the genera of any other area, while in species area 2 is approximately 20 per cent. stronger than area 3, and 33 per cent. stronger than area 7, the next in comparative strength.

(b) The genera and species get less and less as they travel west from area 2 so far as the Fitzroy River (area 8), and that they are mostly Papuan forms, or closely allied to them (1).

(c) The genera and species get less and less the further south they get from area 3, the tropical forms rapidly decreasing in number, and giving place to many Australian-born genera and species.

(d) The desert barrier maintains a difference between the Passerine genera and species of areas 8 and 9.

(e) Area 7 derives its avifauna principally from areas 3 and 6, while the birds of area 9 are derived from areas 7 and 6.

(f) Porphyrocephalus appears to be the only genus common to areas 8 and 9, and peculiar to them, i.e., to the western third of the continent. There are many genera peculiar to the eastern third.

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(1) W. V. Legge, "A.A.A.Sc., vol. x., p. 220, 1904," points out that the avifauna of the Northern Territory would be closer related to that of New Guinea if the physical features and vegetation were not so different. While Colonel Legge sees little affinity between the birds of my areas 8 and 1 and those of New Guinea, I am of opinion that their origin can be traced to New Guinea and to area 7, rather than to Western Austro-Malayasia.

> Emblema is one of the few genera peculiar to the western and central thirds (areas 9, 8, 7, 1).
>
> The eastern third is rich in bird-life, in genera, and species; the central third less so; while the western third is least of all, and not rich.

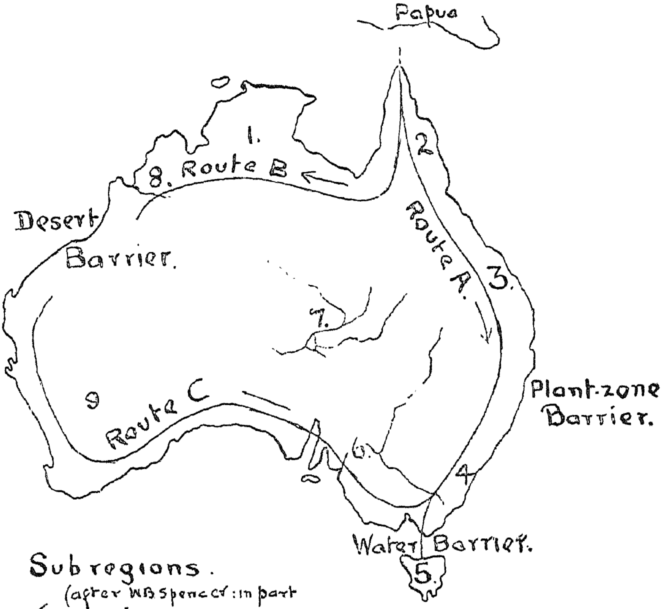
It would appear that the present avifauna of the continent of Australia has been derived for the most part from north-east Australia.

Mirafra, Pomatostomus, and Xerophila appeal to me as being among the few Passerine genera that entered Australia by way of the Timor-Australian land association. They are not Papuan, and the family is unrepresented in that area. Yet Xerophila has in New Zealand the allied genus Certhiparus.

Cape York Peninsula rather than the old connection with Timor is the door into Australia by which the Passeriforms have entered. The Indo-Malayan birds were probably not attracted to this continent, the character of the north-west being indicated in Timor. They passed on to Papua.

A third type of distribution, viz., that from the home nucleus, is shown in the Parrots, the Falcones, the Bower-birds, and the Weaver-finches. Altogether the parrot tribe contains 500 species, well distributed in tropical and temperate countries, the Austro-Malayan being a sub-region of much interest in this respect. It is in Papuasia that we find the nucleus of the parrots of the Australian region, expanding north, east, south, and west. But this distribution from Papuasia specially refers to the fruit and honey-loving Parrakeets and Lorikeets, which may be claimed as being in particular Austro-Malayan. The Broad-tailed, and the Grass-loving Parrakeets, which make up two large genera, are purely Australian. Here we have a fine example of a large sub-region with a physiography of its own evolving the parrot tribe to its own end. This is so as well with the Ploceidæ.

Judging partly from the tables of genera found in area 2, and missing from area 3, and found in area 3 and missing from area 2, the birds of North-east Australia, the stronghold of the birds of the continent, would appear to have had Papuasia as the main station from which emigrated the bulk of our birds. Following that a second and minor station appears to have come into existence, which probably evolved forms from their north-east ancestors, evolved in Australia, and consequently the true Australian fauna.



Subregions.
(after W.B. Spencer: in part)
Torresian 8.1.2.3.
Bassian 4.5.
Eyrean 6.7.9.

Main Routes of Distribution.

ABORIGINES OF TASMANIA.—THE NORMAN VOCABULARY.

The. Rev. James Norman, the author of this vocabulary and the accompanying notes, was for some years attached to a Mission in Sierra Leone. He arrived in Tasmania in 1827, and after temporary employment in Launceston and at New Town, he was appointed in 1832 to the Chaplaincy of Sorell, which at that time included Richmond and Tasman's Peninsula, and extended to Swansea, on the East Coast. His removal to Hobart upon his retirement from Sorell in 1867 was soon followed by his death in 1868. On the day of his funeral all public offices in Hobart were closed by order of the Governor, as a testimony of respect for his long and valuable services to the colony.

THE NORMAN VOCABULARY.

(P. 1) Tragardik, nomercurtick, planewoorack—state of pregnancy; teeaner—come; tooreelur—bread; poornethenar—child, alias pickerninny; moograr—dog; parkalla (adopted)—beef; nummerwar—no; parwar, parwarlar—yes; compomer—man's name; teurar—woman's name; wartermeediar—woman's name; widdererneddier —woman's name; tringhener—to swim; mookenur—water; temorkenur—to drink; tringhener—to swim. (P. 2.) [The natives are in general very adept swimmers, and can pass through the water, performing the most agreeable evolutions, with almost the same ease and rapidity as the piscine tribes themselves.]

Togurlongurberner—to dive. [This duty devolves upon the women, who are held in a state of subserviency by their husbands, and are made not only to provide fish, but to carry heavy burdens, imposed upon them by their unfeeling and ungallant partners. The mode of diving is thus: The female so engaged slings a basket round her neck, and with a stick in her hand plunges into the deep.

After exercising this weapon to disengage the fish from the rock, she rises to obtain breath, and then repeats the operation, till she has succeeded in filling her basket.]

(P. 3) Neunkenar, plegurtethar, nebbelteethenar—eye. [The natives of this country are wonderfully apt in distinguishing objects at a distance. In this they may be said to compete with any people of the world. Their sense of hearing is equally remarkable; and here, we cannot help tracing the goodness of God, in providing for these benighted people such blessings as are meet to secure them from want, and to render them happy beings in common with the rest of the human creation.]

Temokenur—to drink. [I am not aware that the natives have discovered any herbs which are capable of producing an exhilarating decoction. It has been found, however, that in connection with the rest of the human (P. 4) species, they soon contract a fondness for spirituous liquors, and are equally liable to its concomitant effects.]

Mokerloobrer—mouth; tegurner—to eat; teemurladdenarne—ear; toppeltee—go; dereuner, neandrarner—trinket. [The natives are very proud of ornaments, and set a particular value on knives. These they use in dissecting their food, and seem to be fully aware of its superior properties as a carving utensil.]

Plonerpurtick—hungry, or, empty stomach; narnerminner, ragurner, parlerterminner—hand; langoonar—foot; neucougular, neugolar, picrackernar, peecackerlemarner—head; weenar, weenarnarne—wood; partroller (P. 5) —fire. [The natives in the interior obtain a fire by rubbing together two pieces of wood—one green and one dry—till the wood ignites by friction.]

Rorertherwartenar—grass; plegurner, lurerener—leg; tooweenyar, larthethelar, warkellenner, larthertegurner—sun, moon; toorar—rain; noonwartenar, eularminner—smoke; marlerpootenar, nornergoodenar—poultry; blagurdeddiar, wordiack—dead. [The mode of disposing of the dead seems to differ in this country. To the (P. 6) southward the body is committed to the flames. As soon as life is extinct a pile is erected and the body left to consume. It is very common for the mourner to preserve the ashes of the deceased by enclosing them in a piece of kangaroo skin (the fur side inwards), and girding them about the waist. This will appear to be the most natural way for a barbarous people to dispose of their dead, and somewhat in accordance with the method adopted by the ancients.]

Tooreenur—sky; monur, noonghenar—forehead; trarwernar, kanewurrar—tongue; warlerminner—lips; leebrerne, lopenarne—house; terrar—to cry; pillermalar,
(P. 7) pickernar, mackererpillarne—to laugh; parmerecoco, garberebobere—gammon; parrarwar—go away; logurner —to sleep; narrerminner, parlerterminner—shake hands; poackerler, parnellar, warkellar—mussel (shell fish); larnar, peurar—stone; pareminner, rapprinner—prickly mimosa; peungurnee, nartick—hot; catorar, warberterteener—posteriors; trungurmarteener, kaarwerrar—thighs; ploner, plaanganer—stomach; lagurnerbarner—
(P. 8) hair; teebrarmokenur—appertaining to a woman; trarwerlarner, narrargoonar, teburcarloonar — breast; pleanerpenner, narnerpenner—knee; ploner boniack (stomach full)—full stomach. [The noun preceding the adjective, similar to the French language.]

Arlenar, peearner, pleeplar—spear; loneroner, memunrack—sick or unwell; neandrarner—chief. [The greatest homage is paid to the chief of a mob, who owes his title to family inheritance. In the event of a demise without issue, a competition commences, and the title is awarded to the best spearsman. The chief is generally remarkable for his superior strength, a cause of which is that he is under no solicitude about his support, which
(P. 9) is abundantly provided both for him and his family through the resources of his subordinates. The appellation of "Chief" is derived from that of a trinket, thereby inferring that this caput is provided with some ornamental distinction to denote his rank.]

· Planduddenar, warteroodenar—native gum tree; parrarwar—go away (imperative); loocropperner—catamaran. [This vessel is constructed by the natives for the purpose of crossing rivers. It is composed of two large sheets of stringy bark, which, after being well seasoned, are fastened together with curryjong bark (a flexible substance which is capable of being reduced to a very thin texture). It is of a buoyant description, but withal so inconvenient and unwieldy, that the mariner is per-

(P. 10) petually up to his knees in water. Some of the blacks are very hardy, and will venture out a long way in this precarious construction, but oftentimes perish in their perilous undertakings.]

Trokenur—to copulate. [Their mode of courtship is both uncouth and arbitrary. If a black fixes his affection upon any particular woman, and she rebuffs his suit, he has recourse to every possible method of tantalisation to render her time burdensome and miserable. He watches over her day and night, and never ceases his fulsome overtures till he has absolutely forced her into compliance for the sake of getting rid of his importunities. Females are estimated according to their (P. 11) strength and their facility in diving. The conjugal state is attended with much drudgery and fatigue on the part of the women, who, though not held in that state of indifference and unfeeling subserviency which characterises other savage nations, are taught to consider themselves subordinate to their husbands, and compelled to submit to their will and pleasure.]

Tronecartee—look, behold; tyaner, teethaner—excremt; noriddiack—no good; karwarler—cold; neener—you; meener—me; carnee—to speak. [Also applied to the neighing of a horse, the snorting of a pig, etc., etc.]

(P. 12) Triagurlugurne, plegurlarner—earth; memunrack, loneroner—sick or unwell. [When a native is overtaken by sickness which creates internal pain, it is usual for him to have recourse to bleeding. The remedy he adopts on the whole is in immediate unison with that deplorable ignorance and barbarity which characterise human nature in its unpolished state. After filling his breast with deep and dreadful gashes till it copiously bleeds, he proceeds to bind his joints with ligatures made of curryjong bark or of the sinews of a kangaroo. If he experiences no relief from this, he gives himself up to the embrace of death, fully convinced that he is propelled to his fate by that irresistible spirit called "Ragurwropper (P. 13) "Lagurwropperne," and therefore that no human means can avert his predestined doom. He then becomes sullen and silent, and pertinaciously refuses to partake of any nutriment save water, of which he drinks to an extravagant excess. This, together with the barbarous process at first resorted to, generally hurries him to an untimely end. The sympathising observer is particularly struck with this instance of the utter helplessness of these wretched creatures, and finds his mind mechanically directed to the adoption of such measures as are calculated to improve their state and to establish that union and brotherly concord which we as Christians, (P. 14) regarding them as the unfortunate creatures of the same Divine hand, should spare no pains to accomplish.]

Weentiennar, partroltiennar—wood ashes; martielcootenar, nonermeenar—to dig; partrollarne, lennar, loeenar—musket; tooyar (adopted)—soldier; nonghenar—to run; larnar, teewartear, noeenar—stone; crackernee—sit down; parconiack, peemar—presently; tagurner—to go; penneagurner, neoonendenar—seaweed; warterpoolyar, nemeener—lazy; caranner—be quiet; arrocare! (P. 15) —an exclamation denoting surprise; lagueropperne—evil spirit. [The blacks of this country, in common with all other ignorant and unenlightened people, are prone to superstition. Thus, they impute to the malignant agency of an evil and overwhelming spirit all the misfortunes and calamities which befall them, a great many of which are doubtless owing to that state of awful wretchedness out of which it hath not yet pleased the Almighty to call them. They believe in supernatural appearances, and have evinced a decided abhorrence on seeing the carcase of a dog which had been hanged. The unfledged imagination in such instances becomes tainted, and gives (P. 16) place to dreams, the delusive tendency of which to a rude mind may be supposed to inculcate a reality. Their belief in ghosts no doubt originates in this very circumstance.]

Perrerpenner, lugurperneller—to throw; martillar (adopted), mutton; neunkenar—to see; wongherne—to stay; marrarwar—to suck; crackerpucker, tarnur—to kill or break; ninghenne—to arrest or take away; planghener—to put or place; coorroo!—an exclamation; marnder—there; trarwernar—to go; parragonee—to give away; (P. 17) peunnerminner, leallerminner—a scorbutic complaint of an irritating nature to which the natives are subject. [In some stages it is really dreadful, and covers the sufferer with one complete and solid mass of corruption from head to foot. It is also infectious. The natives are sensible of its approach, and where a plurality are together, they contrive to rid themselves of it ere it can attain to a head. The remedy they adopt is simple. Having procured a small piece of wood, and sharpened it at one end [and] hardened it in the fire, they commence to probe wherever they can discover a spot that contains the corrupted matter, by the timely suffusion of which the complaint deadens and disappears. This (P. 18) operation, however, is attended with some degree of pain, but is highly efficacious.]

Teuminer, marthereroomenar—nails; weeminer—more; noorneanner—strong; labberar—to look; labberar meener—look at me; chellar!—an exclamation denoting pain; potthenar (adopted)—cuts in the body. [The rank, tribe, and family of a native are known by incisions, which are inflicted about the breast and shoulders, and leave a lasting impression on the body so mutilated.]

Lugurnarmoonar, riagurner—to strike; narnerminner—to touch; narra—he, she, they; teeagurnannerne, tie(P. 19)carnar—flatulent; pyagurner (adopted)—tobacco; newmertewghenar—to rub; martillarghellar (adopted)—goat; pomeway, pewterway—to shut or close; leearway, leangwullerary—to open; worts!—an exclamation denoting pain; leeanner—to bite; neunar—flea. [The natives very partial to—as a food.]

Lagurnerbarner—hair. [The women shave off their hair with a piece of flint or cut bottle, in which they are very adroit; and notwithstanding the uncouth instrument made use of on the occasion, the operation is performed with much apparent ease and without giving the least pain to the subject on whom it is exercised. They assist (P. 20) each other in this office, leaving a slight circular tuft around the head by way of embellishment.]

Pootherenner—sparrow; troonar, nungurminner—long grass; moonar—wattle tree; meetherbarbenar, moighenar—peppermint tree; meethenar, pungalannar—bush; marnar, moonar—gum. [This food is highly relished by the blacks, who devour it in a manner rather surprising to one who can discover none of its palatable qualities. The wattle gum is considered the sweetest and best.]

Moomere—bark; mokenur trarwerlar—salt water or the sea. [Here likewise the adjective follows the noun.]

(P. 21) Maenkoo, maenkannur—star fish; mayerkeperlartee
—toadstool; worrar—to bring; mokenur (water) woorunar
(bring)—bring the water. [The accusative precedes
the verb.]

Teaghener, rappee—to give; larthertegurner—to-day;
parmere, marrarwar, borar—one; pargonee wayabberner
pargonee lucropperner—to pull a boat; marnerminner,
petherwartenar—to spit; peulinghenar, plegaghenar—an
expression for the mode of salutation; plennar, neerar,
neerack, meerorar—mushroom, not eaten by the natives;
(P. 22) marngurner—to roast; pooplanghenack, warkerooner—
to walk; comecartenguner, probritthener—pig; larngerner—
to stare or to track; lumbe—here; canghenne—to
go back; pleallergobberner, loorener—neck; leearmoorar
—a conveyance; languennee—to fold up; perrethener,
lunyer—crow; mokerer—mosquito; troonghenne—to
prick; tallerpereener, narrynar, benghernar—to knead;
tarrargar noonghenar, wolibberner, tarrarnarar—black
beetle; croanghinnee—to climb; wolimmerner, tarrarnderrar—
(P. 23) opossum; pleathenar, terrar, woollar, illar—
kangaroo; linghenee—to fire a gun, to scourge, to flagellate;
pleenduddiack, mancar—raw (relating to meat);
myagurmeener, wyattermeener, pentewartener—blood;
nayameroo carnee, neberle carnee—music. [This
expression is composed of two words; "carnee" implies
to speak. The natives are very sensible to the impressions
of music, and have displayed a feeling almost
amounting to ecstacy on hearing a well-executed sonetta
or vocal glee.]

(P. 24) Leekener, troanghener—nice or palatable; taccarnar,
tanganar—to ascend; wabberkennar, cangurlunghener—
to descend; wyarningherwungherner—a cat, a domestic
cat; lingurninne—to move; callecooghenar, trubrarnar,
neerar—magpie: lecoonghenar, loangare—to blow (an
action of the lungs); narnar, narnarnanne—maggots. [A
large species of grub found under the roots of old trees.
It is evidently a nutritious food, and is much eaten by
the natives. It possesses a sweetish flavour, and, when
roasted, is deemed highly palatable.]

Linghenar, teererluttenar, langurnerrar—wind (an
action of the element); parmerecoco, garberebobere—
gammon, deception; melikener, pigurner—to kiss; toonanarnee—
(P. 25) cockatoo; nebbertaltick, nayendree—to fall

down; rollanner—frog; martheriddenar, peelennar meethenar, leenar—iguana; tringherar, poakalar, meerar, parnllar—native basket. [The basket manufactured by the natives is made of twisted grass, and is a very neat and ingenious piece of workmanship. It is used by the women when employed in diving, and is of a semi-globular shape.]

Worgoodiack—cramp; trarmernar, triannar, penar-
thenar—bone; trogurligurdick, wartherpoothertick—to
(P. 26) hang as a culprit; tuernar, tuernarnar—clothing; neea-
marrar, loantaganar, moomtenar—skin; neugonar, wyan-
gurner, penaghererneener—the act of vomiting; kar-
murar, karndurrenar—to bark; teeanderoodenar, triunyar
—crow (bird); larrenar, larnar—pigeon; deanner, deerer-
witherbrar—hen's egg; poarunnar, paranerrar—wing (of
a bird); warrander—we; loderwinner—white man; wibar
—black man; narrarcooper—very good; payanerberwar
(P. 27) —two; wyandirwar—three; laggur (adopted), like or
resembling; niggur—it; gibbly—food; moleddemer—
country or native place; licanghener, licourar—to take
off; toankhinnee, mokenurminner—to put on; tatroan-
ghiner, oongurlerpooler—to cut; turrurcurtar, turocur-
thenar—grape; pellogannar, ploocriminnar—sprat (fish);
talarprennar (adopted)—turnip; parcoutenar—horse;
(P. 28) lagapack, lagrerminner, langamack—fiddle; neemertee-
kenar, looteeberneenerner, loteeghenar—picture; tyaner-
minner, wayeninner—a large species of ant, commonly
called piss-ant; moonghenar—urine; probridener—wom-
bat; neboolyunar, marnar, marpooemarenar—a fly;
toanner—dull, obtuse; maggurickercarner—a song sung
by the women in a standing posture, and accompanied
by a slapping of the stomach; taggurpeelar, numeno-
peetar—convalescent; pleggurlerminner, triagurbugherne
—dirty; allar! nomebeu!—exclamation indicative of sur-
(P. 29) prise; wateroorarnar, beemguoganar—peach. [This
delightful fruit is not relished by the natives.]

Jackeromenar—big, large; wolligherenperarner—good-bye; peucannar, plooganinner, peunoonghenar—to whistle; kayerpangurner, karnerminner—to coax or caress; keuperrar—kangaroo rat; lillar—waddy. [The natives are very dexterous in the use of missiles. The waddy is generally used to knock down birds. The women sometimes use it as an offensive wapon, and on these occasions become very formidable. A waddy is

about 18 inches in length and an inch and a half in
(P. 30) circumference, is tapered at each end, and well smoothed
off with a flint.]

Nee! nee! nee!—an exclamation to draw the attention; carnerwelegurner—to sing. [This appears to be an indispensable amusement amongst the natives. Upon occasions of joy or sorrow, or when the feelings are particularly excited, it is usual to celebrate their thoughts by singing. It is also resorted to as a pastime. The general character of their songs consists of one dull, monotonous strain, which is, however, by no means harsh or disagreeable.]

Parmerprar—plenty; carmeener—whiskers; cameuner
—under jaw; warkellar—calf of the leg; naarwinner—
upper jaw; laerpenner—kangaroo sinew; crimererrar—
(P. 31) native tiger; telarnter—the back; terrewartenar—
frightened; legurner—to wash, nagunner, nabrucker-
tarner—to wipe; permayniertick—unfinished; peengwar-
tenar—to stake.

BEN LOMOND MOB.

Leemoganner—The Chief.

WOMEN'S NAMES.

Teemee, Mallangarparwarleenar, Pebberpooler, Maytyenner, Poorerplenner.

MEN'S NAMES.

Prignapannar, Peuneroonerooner, Trallarpeenara,
(P. 32) Parthernerpennener, Carnerteetenar, Plaannerooner,
Teetherwubbelar, Neemgurannar, Meewoolibberner, Tee-
lurterar, Planegarrarttothenar, Mayennar, Teetherpooner,
Teewerlerpooner, Troonetherpooner, Terrerpeenerlan-
gunar, Pooroonеenar, Leenercleanghener, Larwarlarpar-
warleenar, Pennerepurwurlennar, Larkigunar, Tewter-
punnar, Naggurpanner, Punnerweeghunar, Treearpan-
(P. 33) ner, Pennerooner, Loonerminner, Tinghererperrar, War-
therlookertennar, Pootherererterrar, Teewerlerpooner,
Plengurerterrar, Pringurtoolerar, Tarthertildrer, Mower-
tennar, Teethermoopelrar, Rangurmanner, Treegurpan-
ner, Ebbelranner, Neandererpooner, Keeterpooner, Tee-
lutterar, Teugurerpanner.

BIG RIVER MOB.

Monterpeelyarter—The Chief.

MEN'S NAMES.

(P. 34) Perrerparcootenar, Tereetee, Morennar, Cupperlangunar, Peurupperlenar, Pyangurerterrar, Neenercleener, Wartermeelutterweener, Waterlookertennar, Tingurerperrar, Parlerterwopittener, Carwerterwinner, Largunnar, Teethernobberlar, Peunerooner, Laartennar, Pebberarnar, Plinghootenar, Parlerpeupertertenar, Warternammertinner, Trarnereener, Narnekranner.

NOTES ON THE NORMAN VOCABULARY.

By Hermann B. Ritz, M.A.

(Read October 10th, 1910.)

The Norman Manuscript, containing a vocabulary and notes on customs in use among Tasmanian Aboriginals, was recently discovered among the archives deposited in the Tasmanian Museum, Hobart, and is now published in full in the Transactions of the Royal Society of Tasmania.

It is of great value, as containing what is probably the only vocabulary now extant in the original manuscript, and also a number of incidental notes written by the same hand.

The authenticity of the document is clearly established by the quality and appearance of the paper and ink, by the peculiar style of handwriting and spelling displayed, and by the nature of the discrepancies between the vocabulary given there from that professedly published from a copy taken from the original manuscript.

The evidence concerning the first and second points becomes convincing on inspection, and on inspection alone. The discrepancies alluded to may, however, properly be touched upon here.

On the first page of the MS. we read an inscription written in pencil by a different hand:—"By the Rev. J. Norman, Sorell, 332 words and 72 names of men and women."

This was probably done by J. E. Calder, to whom the first publication of this vocabulary seems to be due. We read in E. M. Curr's "The Australian Race" (1887), p. 611:—"Norman's Vocabulary.—The following vocabulary, which has never been in print, was forwarded to me by the late J. E. Calder. It was collected by the late Rev. James Norman at Port (?) Sorell, Tasmania, at which place he resided for many years as minister. In what tribes the words recorded were in use is not known."

It may be remarked that "Port Sorell" is an evident error for "Sorell." There was no church at Port Sorell, on the North Coast, in the Rev. J. Norman's time, but there was one at Sorell, where he actually lived as minister from 1832 to 1867.

The author of the MS. came to Tasmania in 1827, not long before the tribal divisions of the Aboriginals were obliterated—in 1853 there were practically no Aboriginals left in Tasmania—and all that can be said of the origin of the words in the Vocabulary is that they do not belong to the Western or North-Western dialects. The dialects have been already discussed by me in a paper which is among the Transactions in 1909 of the Royal Society.

In transcribing the MS. for the printer, the pages have been numbered for facility of reference, and the marks of length or shortness and the accents found in the MS. and in Curr's publication of Calder's list have been omitted, for several urgent reasons. Lower case initials have been mostly substituted for capitals in the Vocabulary, for the sake of simplicity. The English equivalent is preceded in each case by a hyphen, and followed by a full stop.

It will be observed that the alphabetical order and the placing of the English before the Tasmanian words in the Vocabulary, as given in the Calder-Curr list, are not in the MS. There, the words seem to have been put down at random, and the list is occasionally interrupted by notes suggested by the last words listed.

These notes are very interesting in themselves, and specially so because they do not seem to have been incorporated in any of the published accounts of the customs of the Aboriginals of Tasmania. It is probable that Calder sent them to Curr, and the latter ignored them, as unsuitable for his purpose.

In rearranging the words Calder or Curr evidently overlooked the following:—Marlerpootenar, nornergoodenar (p. 5), arrocare (p. 15), ninghenne, coorroo (p. 16), chellar (p. 18), work (p. 19), pootherennar (p. 20), perrethener, tarrarnarrar (p. 22), deanner, deererwitherbrar (p. 26), laggur, moleddemer, talarprennar (p. 27).

A curious discrepancy occurs in the list of names at the end of the MS. Calder-Curr's list gives only three names of the Big River Mob; the MS. gives twenty-three. The missing twenty are found in Calder-Curr's names of the Ben Lomond Mob, but not together, as one might expect when a whole page goes astray, but four in one place, six in another, five in a third place, and five more at the end of that Mob.

Calder-Curr's note, "Sexes of the Big River tribe not distinguished" is not in the Norman MS.; it is above the heading "Big River Mob" instead of below it, and is too vague to be of any value. As a matter of fact, the names used by the Aboriginals were really descriptions of the individuals denoted. Some of these descriptions would, of course, apply to women only, but others were quite general. For instance, "swift foot" might evidently be equally applicable to a man or a woman.

The Norman MS. has several words marked as "adopted," but while in some cases the resemblance to English equivalents is striking, in others it is doubtful, and it would be very difficult for anyone to speak with certainty unless he happened to be present when the word was first adapted to the Tasmanian habits of speech. The words for soldier (tooyer) and tobacco (pyagurner, i.e., bacca-na) seem to be the only instances of nearly certain adaptation; and even of these the latter looks suspiciously like pugana, i.e., tail, suggesting the twisted tobacco used by sailors.

In conclusion, it may be pointed out that Calder's transcription or the work of the printer, or the united labours of both, in many instances make the Calder-Curr words different from the corresponding word in the MS. It will therefore be advisable to base any philological arguments on the latter rather than on the former, especially as they agree with other Vocabularies in a far greater measure.

H. Ling Roth's edition of the Norman Vocabulary in "The Aborigines of Australia" is evidently taken from Curr, as it contains the same peculiar discrepancies, and is, of course, later in date.

NOTES ON THE GENUS LISSOTES, WITH DESCRIPTIONS OF NEW SPECIES.

(Pl. VIII. and IX.)

By Arthur M. Lea, F.E.S., Government Entomologist.

(Read October 10th, 1910.)

This genus of stag-beetles is almost confined to Tasmania (a single species being known from Victoria and two from New Zealand), and in certain districts and seasons almost every old log will be found to cover some specimens of it. Almost all the species, as with most of its sub-family, are very variable in size, in the shape of the mandibles, and in the tibial dentition, so that it appears as if there are many more species than really exist; in consequence several forms of the same species have been described under different names, and in all probability mistakes in this respect will continue to be made, except, possibly even, by those who have large series under examination.

Except in the case of a few very distinct species, it appears unsafe to identify single specimens of the genus from the published figures and descriptions, or to describe such specimens as new. Long series of many species have convinced me that all, or most of them, have numerous varieties, that without intermediate forms appear to be distinct, but which by such intermediate forms can quite readily be recognised as varieties only.

The greatest variation occurs in the mandibles of the males. On some specimens they are twice as large as on others of the same species. A decrease in their size is often accompanied by a decrease in the number of cusps, or these become less pronounced. When clenched also the openings are smaller in proportion, owing to the mandibles being more solid. The head is generally smaller, whilst the punctures, both on the head and prothorax, are usually larger and denser; approaching the female type. An increase in size of mandibles is often accompanied by an increase in the numbers or size of tibial teeth. The cusps often vary in number and size on the different sides of a specimen.

The labrum is subject to variation, especially as regards its median prominence; its apparent shape also is affected by the opening or closing of the mandibles, and it is frequently partly obscured by grease, dust, and mud. Its clothing and the clothing beneath it also frequently affect its appearance, so that whilst at first it appears to be a very satisfactory character, in reality it is of very little use for distinguishing species.

The hind angles of the prothorax appear to be subject to but slight variation within the limits of a species.

The mandibles of the females, although different to a slight extent, inter se, are so much alike that they are practically useless for purposes of identification.

Two curious specimens were before me. One (see figure 42) was an hermaphrodite specimen of punctatus, having the left side male and right female. The other was a variety of curvicornis, having seven legs, the extra one jutting out from the left front coxa. They have been sent for incorporation in the teratological collection of the British Museum.

I have to thank Messrs. Aug. Simson and H. J. Carter for allowing me to see all their specimens of the genus; but in particular Mr. Jas. A. Kershaw, who sent for examination not only those of the National Museum, but also those of the Howitt collection, and as Professor Westwood received several of his types from Dr. Howitt, these were particularly welcome.

LISSOTES CURVICORNIS, Boisd.

Var. subtuberculatus, Westw. opacus, Deyr.

The original description of curvicornis is quite useless, and Parry's remarks (1) are of little use to the general worker. He says, however, that Howitt sent to Westwood "specimens both male and female of L. curvicornis, Boisd., under the name of L. cancroides, Fab., Dr. Howitt stating in his letter that the insect sent as L. cancroides appeared to him to be identical with L. curvicornis, grounding his opinion on an insect he had seen in Count de Castelnau's collection. This view proves to be correct upon comparison of the type specimen with the insect sent to Prof. Westwood."

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(1) Trans. Ent. Soc., 1870, p. 64.

There is in the Howitt collection a male labelled "Lissotes cancroides Fab. Tasmania" (2), and as this presumably is identical with the species sent to Westwood, and stated by Parry to agree with the type of curvicornis, I regard it as curvicornis. In the same writing and the same collection is another specimen labelled "Lissotes subtuberculatus Westw. Hobarton." This also I believe to be correctly named (3), and if this is the case then subtuberculatus is a simple variety of curvicornis.

The species is a rather common one about Hobart and Mount Wellington, and as it varies considerably the specimens at first sight appear to belong to two or more species. The males may be regarded as belonging to the following races or varieties:—

1. CURVICORNIS, Boi (typical). (Figs. 1, 2, 3, 4.)

Rather flat; head and prothorax with a more or less distinct bluish or pruinose gloss. Cuspidate mass of mandibles subbasal, the mandibles when clenched enclosing a large apical space. A rounded, usually shining tubercle, half-way between each mandible and eye. Prothorax with small punctures; apex not subtuberculate in middle.

The female of this form is also rather depressed and its prothorax usually has a bluish gloss.

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(2) Figure 1; a second and identical specimen in the same collection is also labelled cancroides, and from Victoria; but Victoria I believe to be in error.

(3) It agrees well with the descriptions; see figure 5.

2. Var. SUBTUBERCULATUS, Westw. (Figs. 5, 6. 7, 8.)

Narrower and less depressed than in 1, and the bluish or pruinose gloss almost or quite absent. Cuspidate mass of mandibles median, the mandibles when clenched leaving but a small apical space. Cephalic tubercles absent or very feeble. Prothorax with larger and denser punctures, the apex in middle feebly raised, so as to appear like two very feeble converging tubercles.

Females (as also those of 3) rather narrower than the females of 1, less polished, and with coarser punctures.

Some of the narrower specimens of this variety at first appear to belong to Launcestoni, but may be at once distinguished by the elytral clothing.

3. N. var. (Figs. 9, 10, 11.)

Like 2; but prothorax not subtuberculate at apex.

4. N. Var. (Fig. 8 would do for one of the males of this variety.)

Like 3, but each shoulder with a conspicuous spot of golden clothing on both sexes.

This variety I have only seen from the Gordon River (J. E. Philp) and Zeehan (Aug. Simson).

All these forms differ more or less in the cusps of the mandibles, which are frequently different on the different sides of an individual. They all, however, have the elytra more densely clothed and with longer hairs than on any other species before me, and the clothing on each elytron is usually in five or six rows, although the linear arrangement is not very apparent from above. On one of the National Museum specimens of the first variety, and one of Mr. Simson's of the second, there are two distinct foveæ on the prothorax. The prothorax is rather strongly notched on each side of the base. The distinct teeth on the front tibiæ vary in number from four to nine, but are usually six. The length, including mandibles, varies from 14 to 19 mm. The swollen portion of each mandible usually has four or five cusps, and above these is a strong tubercle.

In Masters' Catalogue opacus was ascribed to Parry. It was certainly included in a paper by Parry, but in that paper it was ascribed to Deyrolle, and given between quotation marks, Deyrolle evidently having sent its description (with that of several other species) for inclusion in the paper. It is simply a comparison with obtusatus, and in it there is absolutely nothing to distinguish it from curvicornis, as above regarded. The "two little shining tubercles on the forehead" at first appear to be distinctive, but most of the specimens of curvicornis have two feeble swellings on the middle of the forehead, and these are sometimes rather more prominent and shining than usual, so that they might quite fairly be regarded as small tubercles.

I think it is extremely probable that the type of cancroides is really a form of curvicornis (1), but that could only be determined on comparison with the type.

LISSOTES CANCROIDES, Fabr.

I have seen this name attached to several totally different species, but not one of the more than 500 specimens of the genus before me agrees with Westwood's remarks (2) on the type, and in particular "the prothorax—the anterior margin—with a small simple (not bipartite) raised tubercle in the middle, close to the fore-margin"; and again, "prothorax with a small central frontal polished tubercle." Parry also (3) comments on the tubercle. Westwood and Parry only knew the type, and whilst it seems probable that it is really an aberrant specimen of curvicornis, it possibly enough represents an extremely rare species, or one confined to a small area, as several undoubtedly distinct species are.

LISSOTES LATIDENS, Westw. (Fig. 12.)

This name has also been attached to several species, but the only specimen I have seen that agrees with the original description and figure is one belonging to the

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(1) If so it will as the older name take precedence.

(2) Trans. Ent. Soc., London, 1871, pp. 371-373.

(3) L.C., 1870, p. 65.

Howitt collection, and bearing a green number label "1358," and a blue label "Dorcus near cancroides," but without a locality label. Westwood, however, received the type from the late Dr. Howitt, and gave the locality as Maria Island, and the east coast of Tasmania.

LISSOTES OBTUSATUS, Westw. (Figs. 13, 14, 15, 57.)

A rather solidly-built species, more widely distributed in Tasmania than any other. There are specimens before me from Hobart, Mount Wellington, Ben Lomond (4,000 feet), Mole Creek, Great Lake, Huon River, Parattah, etc. One (Fig. 13) bears the Rev. T. Blackburn's label obtusatus, and two others from the Howitt collection are so named (one of them, however, probably in error, is labelled as from New South Wales.)

The males vary in length from 13 to 19 mm. When clenched their mandibles usually leave two openings—a small one at the apex, and a somewhat larger one at the base; but the apical one appears to be frequently absent.

LISSOTES LAUNCESTONI, Westw. (Figs. 16, 17, 18, 19, 20, 21, 22.)

Commented on by both Westwood and Parry as close to obtusatus. Parry remarks (1):—"It is the opinion of certain entomologists that this may ultimately prove to be a mere local form of L. obtusatus." The differences pointed out by Westwood, however, appear to be constant, but the two species, or races, may usually be readily distinguished by the mandibles; when agape in Launcestoni, each is seen to have a strong conical projection near the base, and even when clenched the projections are visible. In obtusatus each mandible is there usually more or less evenly rounded off (2), but there are several intermediate forms before me. But even if Launcestoni is to be regarded as a variety, it is one well deserving of a name.

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(1) Trans. Ent. Soc., 1870, p. 97.

(2) Compare figures 16 (Launcestoni) and 15 (Obtusatus).

One of the specimens before me bears a label of Mr. Blackburn's, "Seems identical with a Lissotus I am describing as new (1), mandibs a little different, but that is a very frequent occurrence in Lissotus." Another bears his label 'forcipula.' These two specimens differ considerably in size, in shape of the mandibles, and punctures of the prothorax, but I am convinced that they are simply forms of Launcestoni."

The female, unknown to Westwood, differs in being smaller and rather more depressed, prothorax more rounded in front, with median line more conspicuous, punctures coarse, denser, and more uniform, head much smaller, with coarser and denser punctures and the mandibles of the usual female form.

Hab.—Wynyard, St. Patrick's River, East and West Tamar, Strahan, Launceston, Beaconsfield, Mole Creek, Zeehan, Frankford, Ulverstone, Burnie.

LISSOTES MENALCAS. Westw. (Figs. 23, 24, 25, 26.)

Readily distinguished from all other species by its high polish, peculiarly shaped prothorax, and largely excavated head. Each mandible has two apical cusps, and a strong sub-conical tubercle on the upper surface rather close to the apex. When clenched the enclosed space is large and single. The labrum is sometimes feebly notched at its apex, but is generally obtusely triangular, and is sometimes slightly upcurved at its tip. The distinct teeth on the front tibiæ vary in number from six to nine, but are usually seven. The length varies from 16 to 24 mm.

It is perhaps the most distinct species of the genus, but is rare in collections. I have seen several other species labelled menalcas, but although in some respects they agreed with the original figure, they were all without the high polish characteristic of this species, and which at first sight causes the males to appear as if coated with black enamel.

The female, unknown to Westwood, is also highly polished, but the polish is less conspicuous owing to the punctures being much denser and larger, especially on the head and prothorax. The prothorax is smaller and less convex, with the median line wider and deeper, and the middle of the apex scarcely bilobed. The head is much smaller, the labrum apparently always notched, and the surface immediately behind the labrum raised into a subconical but obtuse tubercle. The mandibles are of the usual female type.

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(1) Mr. Blackburn evidently abandoned his intention of describing species of Lissotes.

The species was recorded by Westwood from New Holland, and as possibly from New Zealand, but is probably confined to Tasmania. The specimens before me are from Long Bay, Three Hut Point, and Mount Wellington.

LISSOTES FORCIPULA, Westw. (Figs. 27, 28, 29, 30, 31.)

Ten males, all from about Hobart, appear to belong to this species; they vary in length from 9½ to 12½ mm (1). The teeth of the front tibiæ vary in number from three to five, and are usually four (on the type there were five). The mandibles usually sweep round as in the original figure, but the tips are not exactly alike on any two specimens. On some very small ones the enclosed space is considerably smaller in proportion than on the larger ones. Westwood makes no mention of clothing, but on the figure the sides are drawn as setose. On all the specimens before me each elytron has fairly long hairs in five rows, and with some much shorter hairs, also in rows; but they appear to be all rather easily abraded, and the linear arrangement is not at once apparent.

Two other males (Fig. 31) differ from the more typical specimens in having the mandibles terminated by two simple cusps, with the inner apical portion narrow and simple.

LISSOTES SUBCRENATUS, Westw.

Only the female of this species was described by Westwood, and until the male has been described after a careful comparison with the type itself, it seems very undesirable to identify any species as subcrenatus. It is to be regretted that Westwood's original intention [1] not to describe the species until the male was known was not adhered to.

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(1) The type was described as six lines in length, but the indicator at the side of the figure is nearly seven lines.

LISSOTES FURCICORNIS, Westw. (Figs. 32, 33.)

Readily distinguished from all other species by the peculiar mandibles and strong cephalic tubercles; the latter, however, are much less conspicuous on small specimens than on large ones. The length, including the mandibles, varies from 12 to 20 mm.

It appears to be confined to Victoria, and is the only ex-Tasmanian species known to me.

LISSOTES RUDIS, n. sp. (Figs. 34, 35, 36, 37, 58.)

Male, Black; sides setose.

Head wide; a strong projection behind each eye and a less distinct one in front; front somewhat obliquely and feebly flattened; with large round punctures, dense at the base and sides, and becoming sparser and smaller elsewhere, and almost absent from the middle of the front. Labrum rather feebly pointed. Mandibles moderately stout, about as long as head or somewhat longer, strongly concave at inner base; with a strong projection near base, upper surface with a strong projection at middle, lower surface between this and apex with a bi or tri cuspidate mass. Prothorax very little, or not at all, wider than widest part of head, sides finely serrated and gently rounded, towards base somewhat oblique but not notched; apex widely rounded in middle, somewhat flattened or feebly depressed along middle, on each side of which the punctures are smaller and sparser than elsewhere, where they are dense and rather coarse. Elytra with shoulders slightly projecting laterally; densely and coarsely punctate; striæ and interstices very feebly defined. Length, excluding mandibles, 12½—20 (female 12—15) mm.

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(1) Trans. Ent. Soc., 1870, p. 98.

Female differs in having the head much smaller, its sides not projecting behind eyes, punctures much denser and more evenly distributed; mandibles very acute at tip, and each with a single acute submedian tooth; prothorax no wider than elytra, sides more rounded and with somewhat denser and more uniform punctures, and elytra with rather smaller punctures.

Hab.—Tasmania: George's Bay, Forester River, Denison Gorge, Lottah (Aug. Simson), Sheffield (H. J. Carter from H. H. D. Griffith), Frankford, Wilmot, Ulverstone (A. M. Lea).

One of the specimens (Fig. 34) before me bears the Rev. T. Blackburn's label, "Lissotus menalcas Westw.," and on this authority I previously distributed under that name many specimens of the species; but it is not even close to menalcas, being subopaque, the average size smaller, mandibles different both from above and from the sides, head not largely scooped out in front, prothorax much less convex, with sides very different, etc.

A subopaque rough species, of which specimens are usually above the average size of the genus. Some of the smaller males have the head not much larger than those of the females, with the mandibles considerably reduced in size. When the mandibles are clenched the strong basal projections, which vary considerably, almost meet considerably in advance of the labrum. The cusps towards the apex are nearly always two or three in number, but are sometimes very feebly defined. The smooth spaces on each side of the middle of the prothorax are more distinct on some specimens than on others, but are never as distinct as in the two following species. The front tibiæ have two very strong apical teeth, and usually three or four other fairly strong ones, and there are generally a few smaller ones, some of which are often inserted between the fairly strong ones. The elytra are usually glabrous except at the sides, but on an occasional specimen a few short hairs are scattered about its surface, and more or less linear in arrangement.

In this and the following species I have not described the punctures of the under surface, as they are invariably coarse or fine according as to whether they are coarse or fine on the upper surface. The large punctures on this species (also with other species of the genus) are often filled with mud, so that, to the naked eye, specimens often appear of a dingy brown.

LISSOTES CONVEXUS, n. sp. (Fig. 38).

Male, Black, shining; sides setose.

Head wide; eyes nearer the base than usual, the sides behind them not projecting and no wider than, if as wide as, the space across the eyes themselves; sides in front of eyes narrow and flattened, but not projecting. Rather convex, apex in middle almost vertical and feebly concave, with large, round, dense punctures at the sides, becoming much smaller and sparser elsewhere, and in some parts entirely absent. Labrum moderately long and pointed in middle. Mandibles comparatively slender, each with a large obtuse projection at side of labrum, upper surface from middle to apical fourth with an obtuse ridge, ending in an obtuse projection, lower surface between this and apex usually with a strong cusp and a very feeble one. Prothorax slightly wider than head, sides finely serrated and gently rounded, towards base slightly incurved, but with the hind angles almost rectangular, flattened or very feebly depressed along middle; with punctures varying from very minute to very large, and irregularly distributed, a conspicuous smooth space with very sparse and minute punctures along each side of the middle. Elytra with feebly projecting shoulders, with dense but not very coarse punctures, of which two or more are frequently connected by fine transverse or oblique scratches; interstices and striation ill defined. Length, 13—16 (female, 11½—12½) mm.

Female differs in having the head much smaller, with denser punctures of more uniform size, eyes more conspicuous, mandibles of the usual female type; prothorax smaller, sides more rounded and more strongly serrated, with the shining spaces much less conspicuous, and elytra with somewhat sparser punctures.

Hab.—Tasmania: Burnie, Marrawah (A. M. Lea).

There are five males before me and two females, and I have described them as representing a distinct species. But possibly they represent an extreme variety of the preceding species. They differ from it, however, in being more convex (both sexes), the males with the projection at the inner base of each mandible larger and more obtuse, the tips somewhat different, the distance across the eyes actually the widest part of the head, instead of with projecting lobes in front of and behind same. They also are quite black and shining, although without the enamelled appearance of menalcas, so that altogether their general appearance is strikingly different. The female differs from the female of that species in the head having somewhat sparser punctures, eyes more prominent, each mandible with its tooth rather nearer the apex, and not quite so acute, prothorax slightly longer in proportion, and elytra with somewhat sparser punctures.

Each mandible could scarcely be regarded as having a cuspidate mass, as the subapical cusp is the only distinct one, and this is so close to the apex that the apex itself appears bicuspidate or notched. Some of the punctures on the front of the prothorax, but not in the middle, are larger than any on the head. There are usually six strong teeth on the front tibiæ.

LISSOTES PUNCTATUS, n. sp. (Figs. 39, 40, 41, 42, 43, 44, 45, 46).

Male, Black, subopaque; sides setose.

Head wide, moderately convex, scarcely or not at all concave in middle of apex; sides slightly projecting behind eyes, and feebly or not at all in front of same. With dense, large, round punctures at sides, becoming smaller and sparser elsewhere, and sometimes absent from certain parts. Labrum strongly but obtusely produced in middle. Mandibles usually rather slender, each with a strong projection close to labrum; upper surface with two projections beyond the middle, lower usually with a strong cusp near apex, and a very small one behind it. Prothorax slightly wider than head, sides feebly serrated and gently rounded, becoming oblique or very feebly incurved towards base; apex feebly rounded in middle; flattened or very feebly depressed along middle; with dense coarse and irregularly distributed punctures, but along each side of middle smooth and with very minute punctures only. Elytra with feebly projecting shoulders;

very densely and coarsely punctate; striation and interstices very ill-defined. Length 13—17 (female 12½—15) mm.

Hab.—Tasmania: Zeehan (K. Findlay), Strahan (Aug. Simson), Magnet (O. L. Adams), Waratah (A. M. Lea).

Westwood's figure of crenatus will give a good general idea of this species, but the tips of mandibles, middle of prothorax, and mentum, etc., are different. The smaller specimens in some respects are close to the description of forcipula, but the head is convex, and Westwood's remark, "the anterior portion forming a large semi-circular depressed space, extending from the outer angles of the base of the mandibles nearly to the hind margin of the head," does not apply to one of the 65 males before me. Forcipula also is a considerably and consistently smaller species, with different punctures and clothing, and so far as I am aware only occurs about Hobart, whilst this species is only known from the west. At first sight it is very close to rudis, but the mandibles are less robust, and when seen from the sides appear tricuspidate, instead of bicuspidate, this being consistently the case in all the numerous specimens of both species before me, except in a few with much smaller mandibles than usual. Compare figures 34 and 35 (rudis) with 39 and 40 (punctatus).

On an occasional specimen there are a few hairs or setæ on the elytra, in addition to those on the sides. The mandibles when viewed from the sides appear to have two more or less conjoined tubercles on the upper surface, and these vary considerably in elevation and in size; there is usually also a swelling below them, so that the lower surface appears to be tricuspidate. Most males have the mandibles strongly curved and rather long, but on some small specimens they are shorter and stouter, so that when clenched the space they enclose is very much smaller in proportion than on the larger specimens. These small specimens also usually have the cephalic punctures considerably denser. The front tibiæ usually have five or six strong teeth, with usually smaller ones inserted between them (except between the first and second); but they are often different on the different sides of an individual.

The female is scarcely distinguishable from the female of rudis, and it differs from its male as does the female of that species.

LISSOTES CORNUTUS, Boileau. (Figs. 47, 48.)

Male, Black, feebly shining; sides setose, the elytra less conspicuously than usual, but in addition nearly every puncture has a short stout seta.

Head very wide, sides behind and in front of eyes feebly or not at all projecting, near each side and close behind the mandible a slight swelling (scarcely a tubercle), with a conspicuous medio-frontal subconical tubercle; towards sides with large, round, dense punctures, becoming smaller and sparser elsewhere; a narrow apical space highly polished and impunctate. Labrum acutely produced in middle. Mandibles strongly curved and rather thin, each strongly and obtusely produced close to labrum, upper surface obtusely tuberculate at middle of base (sometimes very feebly so), and close to apex with a strong projection directed upwards, or upwards and backwards; lower surface usually with a moderately strong cusp close to apex, and one or two very feeble ones behind same. Prothorax distinctly wider than head, sides finely serrated and scarcely rounded, near base somewhat oblique, with the hind angles widely rounded, apex gently rounded in middle, flattened along middle; with dense, rather coarse, and somewhat irregularly distributed punctures, but apical half with an impunctate or almost impunctate space along each side of middle, and conjoined in front. Elytra with shoulders scarcely at all projecting; with very dense but irregularly distributed punctures of moderate size, quite absent from the suture, which is highly polished; striation and interstices very ill-defined. Length, 14—18 (female 12—16) mm.

Female differs from the male in having the head much smaller, with denser punctures of more even size and distribution, the medio-frontal tubercle rather less, and the sublateral swellings rather more, conspicuous; mandibles of the usual female type, prothorax no wider than the elytra, its sides more rounded and with stronger serrations, smooth spaces much less defined, and elytra rather more coarsely and evenly punctured.

Hab.—Tasmania: Stanley, Zeehan (Aug. Simson), Zeehan (K. Findlay), Magnet (O. L. Adams), Waratah (A. M. Lea). (1)

In general appearance close to rudis and punctatus, but readily distinguished from those, and in fact from all species of the genus, by the conspicuous medio-frontal tubercle, in front of which is a narrow highly polished and impunctate space, extending almost the entire width of the apex; the suture is smoother than in other species of the genus, and the elytra are usually feebly alternately striped with black and dark brown, but the stripes are not always traceable.

The setose clothing of the elytra is shorter and stouter than usual, so that in fact many of the setæ might quite fairly be regarded as scales; they are usually more noticeable towards the sides and apex, but that is probably because those parts are less subject to abrasion. The front tibiæ usually have five or six strong teeth, with a few smaller ones. The female in general appearance is much like that of the preceding species, but may be readily distinguished by its suture, which is much as in the male, and by its medio-frontal tubercle.

LISSOTES LATICOLLIS, n. sp. (Figs. 49, 50, 51).

Male, Black, shining; sides feebly setose.

Head wide, base rather strongly convex, front strongly sloped and widely but rather shallowly concave, towards each side at about one-fourth from the apex with a strong and somewhat conical tubercle; sides behind eyes somewhat swollen, but not conspicuously projecting, in front of eyes feebly incurved to near apex, with moderately large and fairly dense punctures close to eyes, but elsewhere much smaller, sparser, and irregularly distributed. Labrum wide, obtusely notched in middle. Mandibles moderately stout, each at base wide and concave inwardly, swollen near labrum, apex with a small but acute notch, upper surface near apex with a strong upward projection. Prothorax larger than usual, distinctly wider than head, sides almost smooth and more rounded than usual, hind angles widely rounded, apex almost truncate across middle, with the outer angles very feebly produced, middle not at all or very feebly impressed along middle; punctures fairly large at base and sides, but elsewhere small and sparse. Elytra less parallel-sided than usual, shoulders not projecting laterally; with moderately dense but rather small punctures, very sparse along suture; striation and interstices rather feebly defined. Length, 16—19 (female 14—16½) mm.

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(1) Recorded by Boileau as from Australia, but probably confined to the north-west and west parts of Tasmania.

Female differs from the male in having the head much smaller, with coarser and more evenly distributed punctures, tubercles represented by slight swellings, mandibles of the usual female type; prothorax smaller and no wider than elytra at their widest, sides more evenly rounded and with somewhat stronger punctures.

Hab.—Tasmania: Zeehan (Aug. Simson and K. Findlay).

A large strongly convex species, with wide prothorax, and conspicuously bituberculate head, and usually with the labrum feebly notched in the middle. The tubercles are very distinct on all the six males before me, but vary somewhat in size. Two specimens have the elytra indistinctly diluted with red. The elytra have numerous small oblique scratches, many of which start from punctures. To the naked eye from certain directions the striation and interstices are fairly distinct. There are usually five strong teeth on the front tibiæ.

LISSOTES POLITUS, n.sp. (Figs. 52, 53.)

Male, Black, shining; sides feebly setose.

Head large, rather longer than usual, and with the frontal slope unusually long and feebly concave; sides behind eyes evenly rounded, but in front of same strongly projecting and then very strongly incurved; greater portion of surface smooth and with small punctures, but towards each side, from close to eye to where it joins with the lateral incurvature, abruptly vertical or slightly overhanging, the space so marked off with coarse sculpture. Labrum somewhat acutely produced in middle. Mandibles stout at base, strongly angular close to labrum, then strongly curved to apex, where each is rather narrowly notched, with the apical projection rather longer than the other; near apex with a strong projection (almost as long as the portion of mandible in front of it) somewhat curved, and directed upwards and inwards. Prothorax slightly wider than head, sides smooth and parallel for most of their length, hind angles widely rounded, apex very feebly rounded in middle; sides and base with dense and rather coarse punctures, elsewhere with sparse and minute ones. Elytra with shoulders rounded off; with dense and comparatively small punctures; striation and interstices fairly distinct. Length, 17 mm.

Female unknown.

Hab.—Tasmania (F. A. Rodway).

A very distinct species, although somewhat resembling the preceding at first sight; but the mandibles are very different about the apex, the labrum is pointed in the middle, the head is without conspicuous tubercles above the eyes, and the sides in front of the eyes are largely scooped out, and with the disc marked off from the sides by abrupt and slightly overhanging walls. The head of the type, measured along its middle, is longer than its prothorax, and its punctures, except at the sides, where, however, they are very confused in parts, are very small. The upper tine of each mandible is much more conspicuous than on either the preceding or following species. The two front teeth of the front tibiæ are of normal size, but the others are rather smaller than usual. The coarse punctures on the prothorax are all submarginal, but there are a few of moderate size about the middle slightly in advance of the base.

A smaller (15 mm.) specimen differs from the type in having the head considerably smaller, with the frontal slope and the punctures much more conspicuous, the mandibles stouter and shorter, with their sub-basal projections more obtuse, but the tips and the upper tines are the same, except that they are somewhat smaller; the prothorax is smaller, with the sides more rounded; the elytra have smaller punctures, and the front tibiæ have more and stronger teeth.

The two males before me are without locality labels, and I thought they were possibly from the West Coast, but Dr. Rodway on being applied to wrote of them:—"I got your note re Lissotes, and am sorry that I cannot be sure as to the locality. It was obtained near Hobart, and I think probably from a ti-tree swamp beyond Kingston, where I often used to go for beetles. They are not from the West Coast; I am sure of that."

LISSOTES RODWAYI, n. sp. (Figs. 54, 55).

Male, Black, some parts dark reddish brown; moderately shining; sides fringed with rather long setæ, and a few scattered about on the posterior slope of the elytra.

Head large and moderately wide, rather strongly convex; sides moderately projecting both in front of and behind eyes, with a slight swelling near each side in front, but scarcely tuberculate; towards sides with dense, large, round punctures, smaller near base, and smaller and sparser and somewhat irregularly distributed elsewhere. Labrum feebly incurved to middle of apex, with a slight projection over the middle. Mandibles not very stout, except at base, where each is strongly produced at the side of the labrum, apex rather strongly notched, upper surface near apex with a strong projection directed upwards and inwards. Prothorax not much wider than head, and very little, if at all, wider than widest part of elytra; sides very feebly or not at all serrated, apical two-thirds almost parallel, thence oblique to base, with the hind angles widely rounded; apex gently rounded across middle, with a comparatively narrow and distinct median line; punctures for a narrow space dense and rather coarse along sides and base, about the same size but sparser along middle; elsewhere with rather small but fairly dense punctures. Elytra not quite parallel-sided, shoulders rounded, with moderately dense but rather small punctures, becoming denser at the sides and posteriorly; striation and interstices rather ill-defined. Length, 16½—17 (female 15) mm.

Female differs from the male in having the head much smaller, less convex, with denser and mostly coarser punctures, the sides scarcely projecting either in front of or behind eyes; mandible of the usual female type; prothorax less transverse, sides more evenly rounded and more noticeably serrated, and with somewhat coarser punctures, whilst on the elytra they are somewhat finer.

Hab.—Tasmania (F. A. Rodway).

In some respects close to the description and figure of crenatus, but considerably larger (this, however, may be of no importance) and each mandible with three plain cusps or tines at apex, front of head almost vertical instead of concave, mentum with corners scarcely rounded off (certainly not "fere semicirculare") and apex of prothorax not truncate (as figured and described). In some respects it resembles the two preceding species, but the head is not conspicuously bituberculate, and the sides are not largely scooped out in front of the eyes.

On three specimens (two males and one female) the prothorax is of a dark reddish brown, and both males have the greater portion of the head somewhat darker but not black; these also have parts of the under surface more or less feebly diluted with red. All three have parts of the legs, and especially the coxæ, also diluted with red. There are two very strong teeth on the front tibiæ, and from three to five others of small or moderate size.

A male from Zeehan in Mr. Simson's collection differs from the types in being entirely black, the head somewhat concave in front, basal projection of the mandibles much less conspicuous, prothorax distinctly wider than elytra, with its median depression wider and shallower, and elytra with rather coarse punctures. The strong teeth on its front tibiæ are six on the right, following each other regularly, and five on the left, with two smaller ones between the third and fourth, and again between the fourth and fifth.

LISSOTES PARVUS, n. sp. (Fig. 56).

Male, Black, somewhat shining; sides fringed with long setæ; elytra in addition with other clothing.

Head wide, moderately convex, with the front slightly concave; sides rounded behind eyes and slightly projecting in front of same; a feeble swelling, sometimes almost a tubercle, towards each side behind the mandible; with rather dense punctures of moderate size, but becoming larger and denser towards sides. Labrum rather feebly produced in middle. Mandibles short and stout, each near base with a subconical projection, then notched, and then feebly undulated or cuspidate to near apex, where there is a feeble notch. Prothorax decidedly wider than head, but very little, or not at all, wider than elytra; sides finely serrated, and towards base feebly incurved, apex very feebly rounded across middle; sides and base with dense and coarse punctures, elsewhere fairly dense but smaller, and smallest about apex. Elytra parallel-sided for most of their length; shoulders slightly projecting; with dense and rather coarse punctures; striation and interstices rather ill-defined. Length, 10—11 (female 9—10½) mm.

Female differs from the male in having the head much smaller, with coarser and somewhat denser punctures, mandibles of the usual female type, the prothorax less transverse, with sides more rounded, and punctures somewhat coarser.

Hab.—Tasmania (Aug. Simson), Hobart (A. M. Lea).

A very small species, in size and, except for the mandibles, general appearance, strongly resembling forcipula, but the mandibles very different from those of that species, or in fact of any other species of the genus, being unusually short and solid.

The clothing appears to be easily abraded, but one specimen in perfect condition has the elytra clothed with rows of long hairs, with short stout setæ, almost scales (as on cornutus) on the interstices, and similar stout setæ are on the sides of its prothorax. But most of the specimens have the long hairs and stout setæ entirely abraded, or greatly reduced in numbers, with the marginal setæ also reduced in numbers. An occasional specimen has most of the derm more or less noticeably diluted with red. The inner edge of each mandible between a rather deep notch in front of the sub-basal projection and a very feeble subapical notch, is sometimes almost straight, but it usually has two or three feeble cusps. There is usually a feeble tubercle on each mandible about its middle, and fairly close to the inner face, but it is not visible from the sides. There are usually five, but sometimes only four, strong teeth on the front tibiæ.

EXPLANATION OF PLATES VIII. AND IX.

Figs. 1*, 2, 3, 4—Lissotes curvicornis, Boi. Heads and front tibia.

Figs. 5, 6, 7, 8—Lissotes curvicornis, Boi, var. subtuberculatus, Westw. Heads.

Figs. 9, 10, 11—Lissotes curvicornis, Boi, var. three. Heads.

Fig. 12—Lissotes latidens, Westw. Head.

Figs. 13, 14, 15—Lissotes obtusatus, Westw. Heads and front tibiæ.

Figs. 16, 17, 18, 19, 20, 21, 22—Lissotes Launcestoni, Westw. Heads and front tibia.

Figs. 23, 24, 25, 26—Lissotes menalcas, Westw. Heads, front tibiæ and upper lips.

Figs 27, 28, 29, 30—Lissotes forcipula, Westw. Heads and front tibiæ.

Fig. 31—Lissotes forcipula, Westw. Head.

Figs. 32, 33—Lissotes furcicornis, Westw. Heads.

Figs. 34, 35, 36, 37—Lissotes rudis, Lea. Heads and front tibiæ.

Fig. 38—Lissotes convexus, Lea. Head.

Figs. 39, 40, 41, 42†, 43, 44, 45, 46—Lissotes punctatus, Lea. Heads and front tibiæ.

Figs. 47, 48—Lissotes cornutus, Boileau. Heads.

Figs. 49, 50, 51—Lissotes laticollis, Lea. Head, front tibiæ and projecting portions of mandibles.

Figs. 52, 53—Lissotes politus, Lea. Heads and front tibiæ.

Figs. 54, 55—Lissotes Rodwayi, Lea. Head and projecting portion of mandible of another specimen.

Fig. 56—Lissotes parvus, Lea. Head and front tibiæ.

Fig. 57—Lissotes obtusatus, Westw. Head.

Fig. 58—Lissotes rudis, Lea. Head removed from prothorax.

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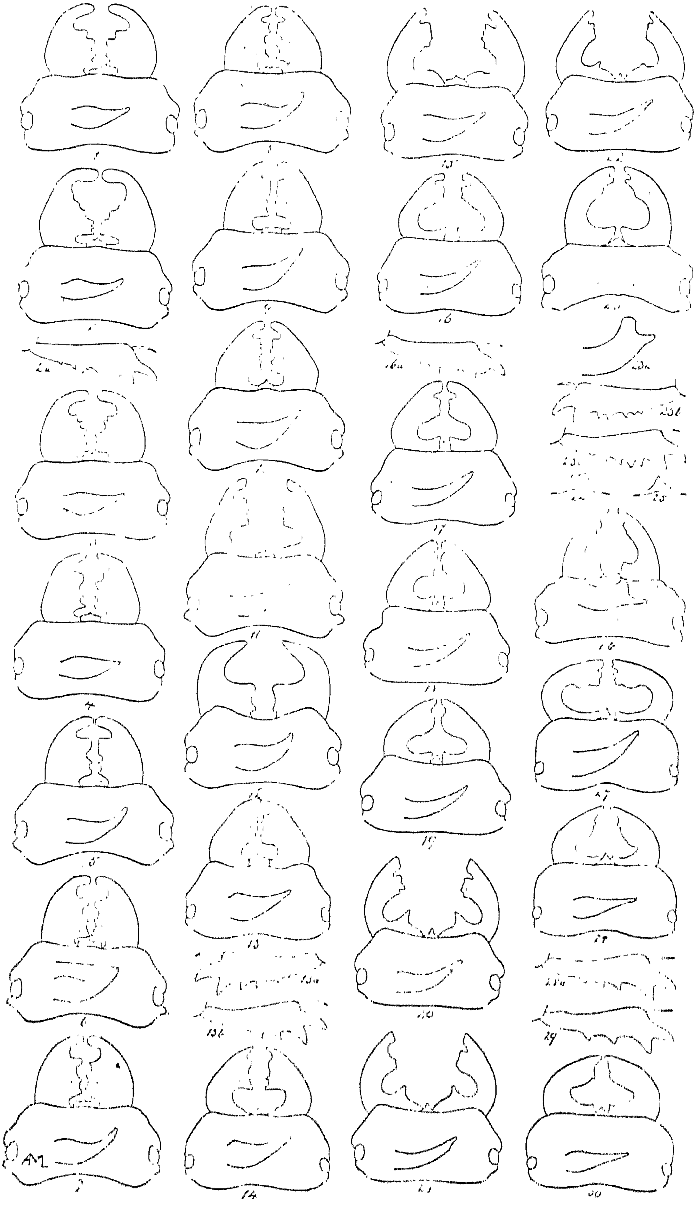
*The inset figure is the projecting portion of mandible, as viewed from the side.

† An hermaphrodite specimen.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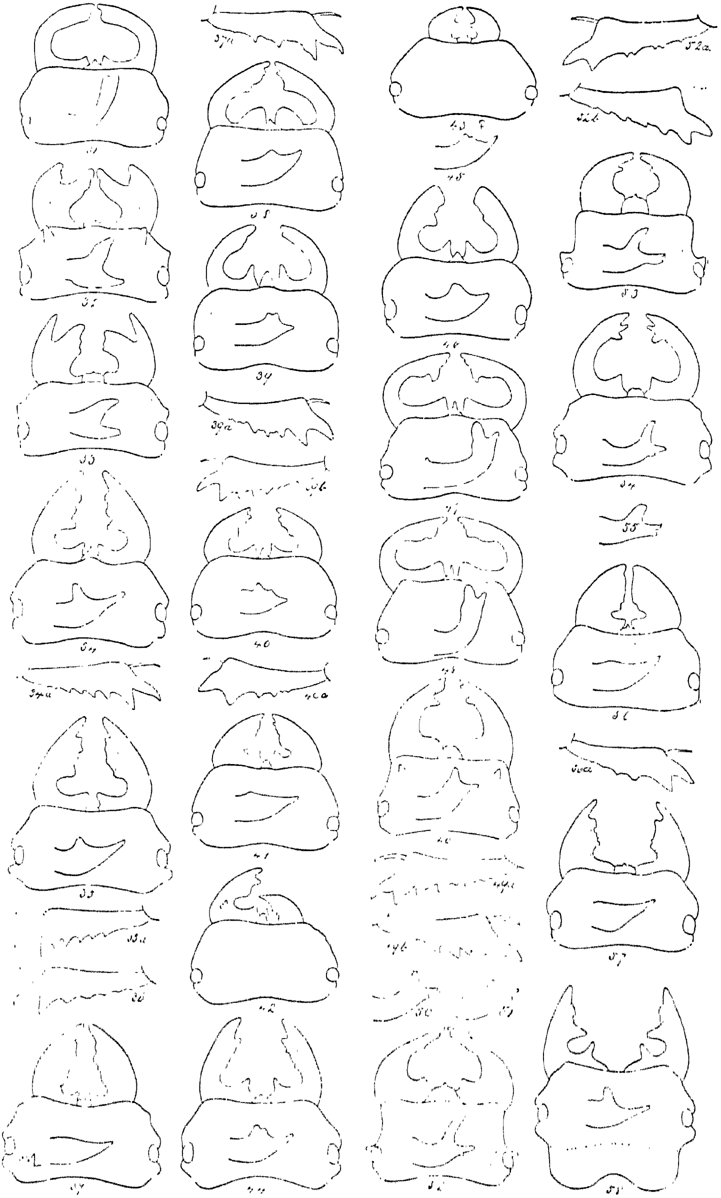


NOTES ON EUCALYPTUS RISDONI, HOOKER.

(PL. X, XI AND XII.)

BY L. RODWAY.

(Read October 10th, 1910.)

The limits that shall be assigned to this species is a puzzle to the student. Hooker described the plant from material gathered at Risdon. He figured it in his Flora Tasmaniæ. It is abundant on the dry hills from Risdon to Rokeby, besides elsewhere, exactly in the form of his description. In this type-form the leaves are opposite, sessile, connate, and so covered with pale wax as to be of a pale glaucous colour. The flowers and fruit differ in no detail from those of Peppermint (E. amygdalina Lab), except that they are larger. The fruit is pyriform or turbinate, even on the same tree, and ranges in diameter from about 9 m.m. to 13 m.m. In E. amygdalina the fruit is nearly always turbinate, and ranges from 5 m.m. to 7 m.m. diameter. These measurements appear to be constant, and may in critical cases be taken as a sign of affinity. We all recognise the close relationship of the two, and the prince amongst Australian botanists, Baron von Mueller, insisted upon combining the two under one name. This is a clubbing that is not likely to be adopted by those familiar with these trees in the forest. Another feature that appears to be constant is that E. Risdoni and its varieties always retain some degree of glaucosity, while in E. amygdalina and its varieties this peculiarity is absent.

The leaves of the typical E. Risdoni are arranged in opposite pairs, and each pair is broadly connate across the stem. They average in length 4 c.m., and in greatest breadth, which is at the lowest third of length, 3 c.m.; they are broadly ovate with usually an acute apex. The leaves vary greatly in shape, in response partly to heredity, partly to local conditions. In this respect the tree seems to respond to the stimulus of nutriment in a truly remarkable manner, but we can generally trace in the plexus of forms two lines of variation, one assuming the character of variety elata, the other of variety hypericifolia. The latter was labelled E. hypericifolia by Robert Brown, and is in Bentham's Flora referred to as a variety of E. amygdalina.

Variety elata is simply a main extension from the type in the direction of an alternate, petiolate leaved condition. The primitive leaves are exactly as in the type, but the mature ones are alternate, petiolate with lanceolate, slightly oblique laminæ, often attaining a length of 15 c.m., and a breadth of 3 c.m.

The type form of E. Risdoni has a very restricted distribution, but var. elata is found almost throughout the state, where it mingles with, and often is taken for, a broad-leaved form of E. amygdalina.

The type appears to be only found on dry, mudstone hills; var. elata thrives in a similar situation, so that its form is not a mere expression of better nutriment. It would be an interesting experiment to note the extent of variation that could be induced in the type by being grown under varied cultural conditions.

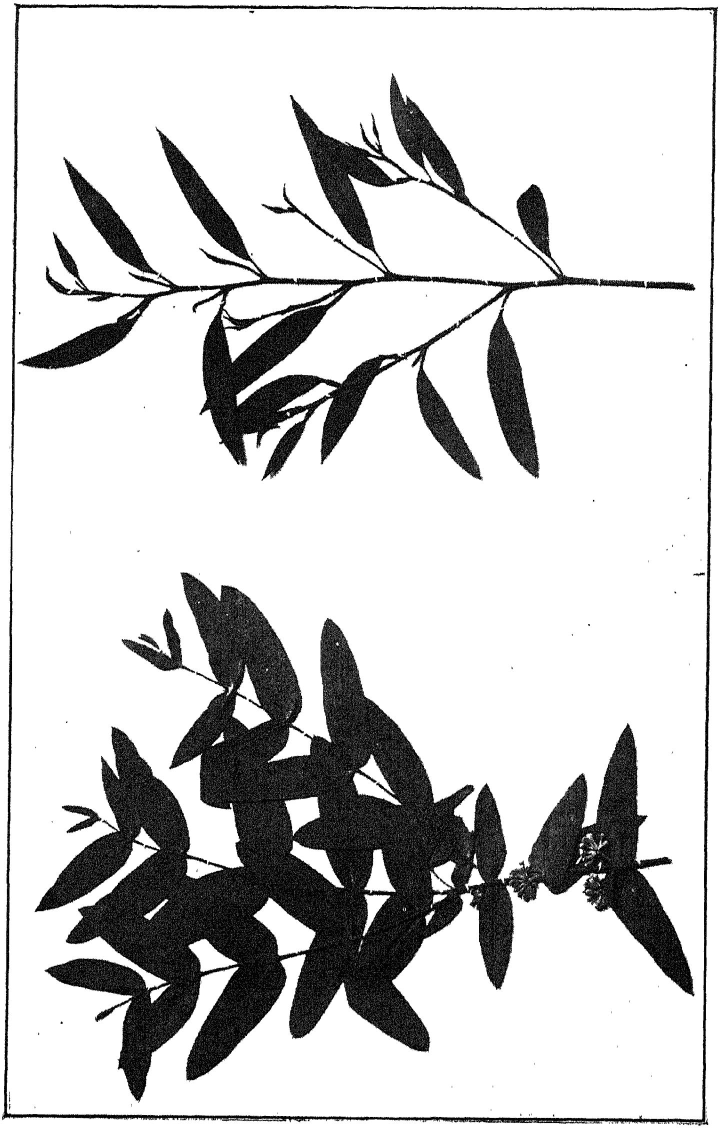
Under the name var. hypericifolia we have to include an assortment of varied forms of an apparently unstable character, which are still closely related to one another. how much of the variation of form is hereditary and how much is merely ontogenetic are factors that remain to be proved. The central form of this variety may be considered to be the following:—

Leaves with a shining surface and of a dull glaucosity, the immature ones lanceolate, sessile in opposite pairs, usually narrowly connate at the base, or even on the same tree broadly ovate and broadly connate, but when so relatively longer than in the type; mature leaves lanceolate to nearly ovate, equal sided, alternate, with a long petiole and elongated, acute apex. The fruit is as large as in the type.

Of the forms observed the following may be referred to:—

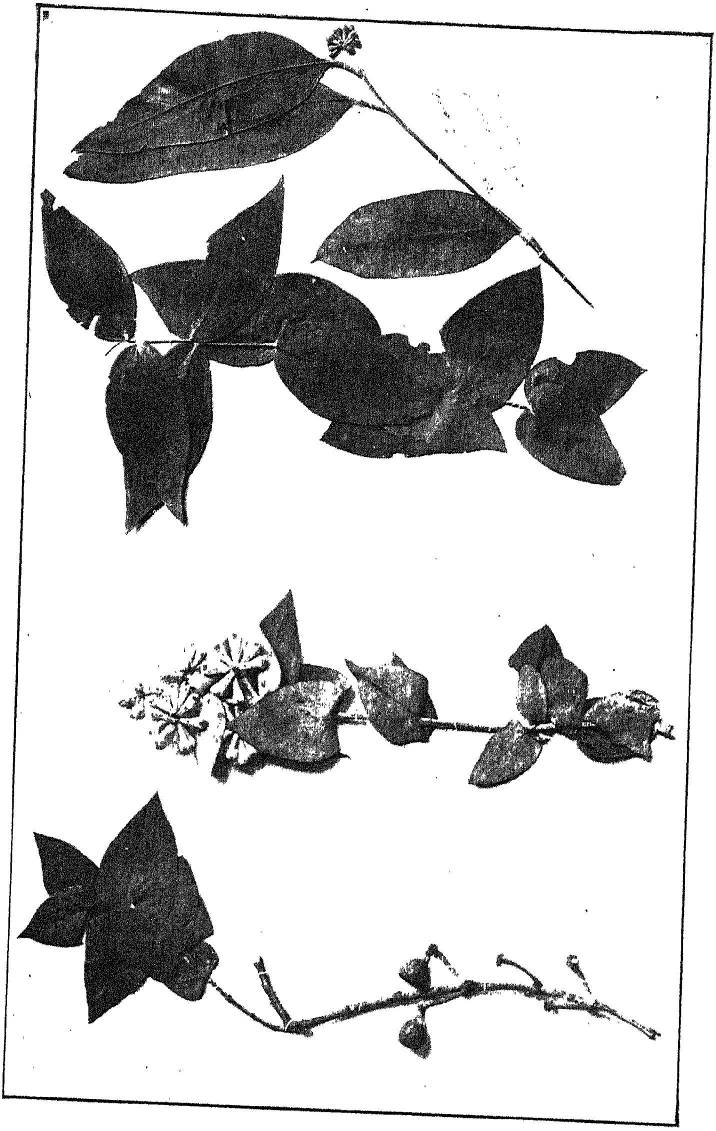
Form a.: Leaves not shining but glaucous, rather small, about 5 c.m. long, lanceolate, opposite sessile, opposite petiolate, or alternate. Fruit relatively small.

Form b.: Leaves dull, slightly glaucous, the mature ones broadly ovate, equal alternate, about 3 c.m. to 6 c.m. long. Fruit relatively small.



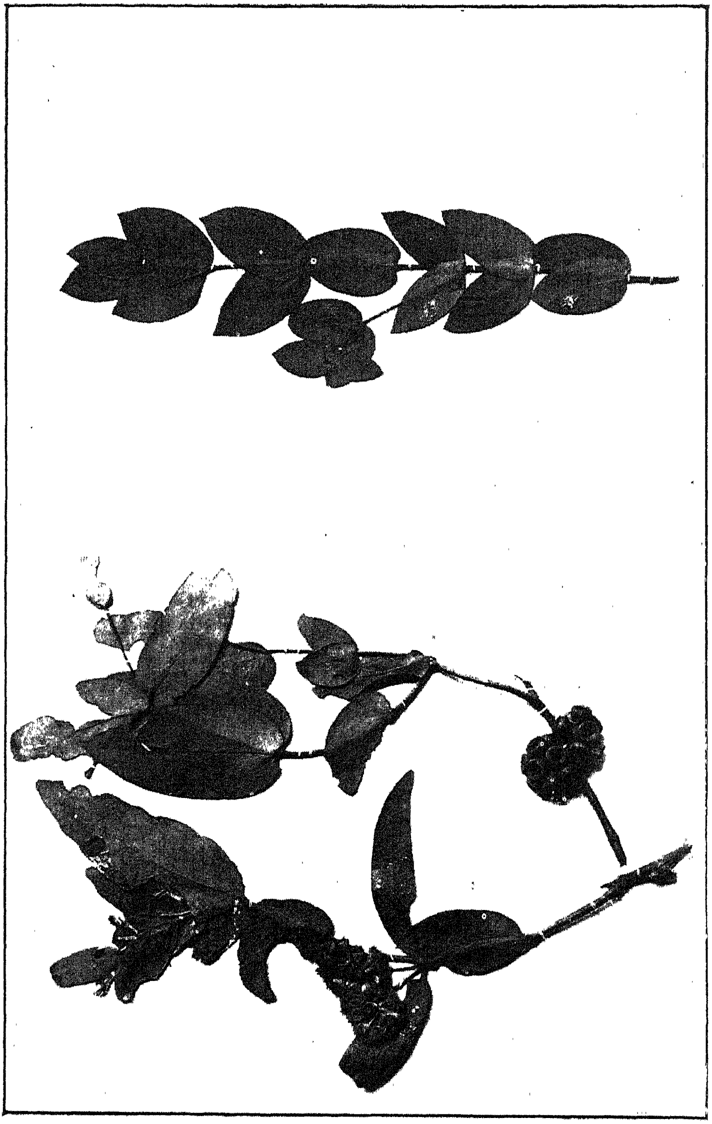
Lower Figure—Second year of seedling of form d.

Upper Figure—Third year of seedling of form d.



Lower Figure--Typical Euc. Risdoni, H.

Upper Figure--Rare, form c



Lower Figure—Form d.

Upper Figure—First year of seedling of form d

Form c.: Leaves broadly oblong, dull, glaucous, equal, 5 c.m. to 10 c.m. long, 3 c.m. to 5 c.m. broad, the immature opposite but seldom connate, the mature ones alternate, petioled.

Form d.: Leaves dull, slightly glaucous, all opposite, sessile, or nearly so, the immature ones connate, the mature ones not so, broadly ovate, but tending to become lanceolate on the upper twigs. Flowers and fruit as large as in the type.

These are not claimed to be stable forms, but rather a statement of individual characters that are met with in the bush. At least the last is purely the result of environment. The tree described grows on the sand dunes at Adventure Bay. Three years ago I gathered seed from it, and raised ten plants in garden soil. All at first bore leaves like the mature parent. At two years seven of them bore opposite, sessile, lanceolate leaves, the other three opposite sessile ovate leaves. The most vigorous of the first lot when only eighteen months old developed a copious crop of flower buds, which have not yet opened. This tree is now six feet high, and the foliage is alternate, petioled, narrow lanceolate, and nearly indistinguishable from that of E. amygdalina.

Form d, as found at Adventure Bay, might well be identified as E. dumosa, A. Cunn, and its offspring in my garden is at present E. amygdalina, Lab. This is a response to changed conditions well worth the attention of students of Eucalypts.

SKIN DISEASES TREATED BY BLOOD VACCINE.

By E. W. J. Ireland, M.B., C.M.

(Read 10th October, 1910.)

Dr. Grove W. Wende, of Buffalo, as Chairman of the Section of Dermatology of the American Medical Association, in an address in St. Louis, June, 1910, devoted his attention to the consideration of Skin Diseases to Medicine as a whole. He laid stress on the fact that specialising in one branch of medicine tended to narrowness of observation and loss of perspective that impaired the broadest utilisation of the observations made. He considered it advisable that dermatologists should make some effort to bridge the ever-widening separation between that specialty and the field of internal medicines. General cases should be sought and discovered, and the work of the clinique and the laboratory should be united in the investigation of causes and broad relations.

With the exception of parasitic and local inflammatory affections of the skin, it may be said that skin diseases are for the most part simply superficial local manifestations or complications of general or special morbid states. Skin diseases, in short, are nothing but symptoms in many cases.

Crude notions of a blood diathesis still persist with the profession. Thus the uric acid diathesis theory of skin affections is nothing but misleading—the cloak of ignorance. There may be an element of truth underlying some of these crude notions, because metabolic processes form the foundation of life, and errors of metabolism may be presumed to account for many of the variations from normal in the different tissues and functions of the body. He nnstances the following diseases as especially calling for co-operation between dermatologists and internists—exudative erythema, aften co-incident with acute nephritis; bronchitis, pericarditis, arthritis, or alimentary canal complications." Many times, he asserts, operations have actually been performed for supposed appendicitis, intussusception, etc., which would have been avoided by a knowledge of the co-relation of such abdominal symptoms with erythemata. He mentions, amongst other skin eruptions as the outward manifestation of internal disease, syphilitic rashes, itchings of urinary meatus, furunculosis, and ulcerations at the base of nail in diabetes, and the eruptions of fevers.

For some months before reading this article I have been looking to the condition of the blood stream for an explanation of some skin affections, and for an indication as to what direction treatment of the condition should take. The routine followed is to take a blood smear from the lobe of the ear or finger, and I have found that from an immediate examination of the hanging drop of blood interesting information as to the exact relation of the lesion through the health of the patient may be obtained.

And in this direction I am convinced more work should be done. By the time a sample of blood has been transferred from the clinician to the bacteriologist, many interesting features to be observed in the fresh blood are lost, and the wonderful check which one has in comparing the fresh blood in the treatment during different stages is missed.

Most cases of skin diseases are generally signs of a general discrasia, and signs of this general discrasia may also be seen in an altered condition of the blood plasma and blood corpuscles.

The improvement of the blood picture as treatment progresses is a most interesting thing to watch, and the simultaneous improvement in the health of the patient shows that normal looking blood is a sufficient and satisfactory index of normal health.

I am dealing more particularly with skin lesions, the effect of treatment on which can be seen by even the uninstructed. Acne is, I believe, mainly a staphylococcic infection of the skin, primarily due to infection of the blood stream either through the tonsils or through the alimentary tract, which, of course, includes the liver.

This explains, I think, the frequent association of acne with adolescence. The teeth are generally in their most offensive and septic condition between fourteen and twenty-one, and the blood stream is more likely to show signs of intolerance at this age when an immunity has not yet been established, and when the general high state of nutrition of the body drives the cocci and the bacilli to the skin glands, especially to the face, where the circulation is probably least effective.

The occurrence of acne about the seat of election of rodent ulcer is suggestive, although the ulcer is more confined in its boundaries. Carbuncle also chooses somewhat the same ground as acne, and also furunculosis, sycosis, seborrhoea, and other staphylococcic diseases.

Allied with the staphylococcus we have a bacillus, but the staphylococcus is most exuberant in its growth, and the rapidity with which fresh crops of acne appear makes it unlikely that the bacillus is the main cause of the eruption.

Skin nutrition and texture, and the much despised diathesis must have something to do with the development of acne. Certainly complexions vary, and the milky and pink and white complexions, either with dark or bright hair, show a wonderful amount of immunity. The muddy, greasy skin is far more liable to the infection; in this skin there is already a tendency to overgrowth of sweat and sebaceous glands, which harbour the coccus, and contain masses of sebum, etc., an excellent medium for its cultivation. The directions given for the obtaining and cultivating of the bacillus of acne are:—A thorough cleansing of the skin over a large acne pustule or spot, the piercing of it with a sterile needle, or glass point drawn out in a flame, the cultivation of the lymph or pus obtained on a suitable medium for at least forty-eight hours, and some instances for a week or a fortnight. The growth thus obtained is said to cause an outcrop of acne pustules where rubbed into the skin of a susceptible person. This has been considered proof that the acne rash is the result of an inoculation of the skin with what is called the acne bacillus.

It is somewhat doubtful whether this so-called acne bacillus is the real or sole cause of acne.

I have recently had under my care several cases of acne of a persistent character. The first was in a young woman of 25 years, who has suffered with amenorrhoea and dismenorrhoea for several years, and whose face has been greatly disfigured by the skin eruption for the past three years. In March of last year she had a trip to Java, and in the tropics the skin became quite clean, probably owing to free perspiration carrying away toxins and flushing the skin thoroughly. On her return to Australia she had three months' treatment with radium in Melbourne, and got back to Hobart at the end of last year free of her rash. The spots began to appear after a month or two, and early in the year I ordered her to bed for a severe attack of pain in the left iliar region—probably ovarian associated with dysmenorrhoea. The patient was very anaemic, with a foul tongue, no temperature, haemic sounds in pulmonary area, and re-duplication of apical sounds. She remained in bed three weeks, and treated the rash with radium; the diet was restricted to milk. For several days nothing but milk was given, a little fruit, but no eggs or meat allowed. The general condition improved, and the face became almost quite free of acne, but as spots continually appeared, I made an autogenous vaccine, and injected it a few times. This culture, after twenty-four to forty-eight hours, contained large staphylococci alone, but after a week numerous bacilli made their appearance actively mobile, and very like the bacillus coli in movements and staining. The patient, after two or three injections, went to Sydney for the winter, and remained free of the acne until lately, when it returned on her arrival in Melbourne. I think that with a longer treatment of autogenous vaccine I should have obtained a perfect result, judging from subsequent experience. The blood was not examined in this instance.

Since this I have made a routine of blood examination in every case, and have checked the improvement of the patient by the blood picture.

Another case of acne was in a young girl of 17 years, who had tried state school teaching, but had been obliged to give it up on account of severe headaches, shivering and vomiting attacks occurring at short intervals. In this patient the blood showed excess of blood platelets, and many small leucocytes, with a low haemoglobin index, and a general leucocytosis. Some cocci and bacilli were visible in the blood plasma, and some of the cells also seemed to contain cocci. An acne vaccine was made from the blood drawn through an acne nodule. The skin of the forehead was thoroughly scrubbed with ether soap and absolute alcohol, and then collodion was painted over the spot to be pricked, and the blood taken from the surface of collodion as it welled through. The skin was so thoroughly treated that it peeled off the forehead for the next week or so.

A culture of the blood gave numerous cocci and some bacilli, which formed small, gaseous bubbles in the neutrient agar. Injection with a vaccine made from this when given too freely on one occasion brought on a severe attack of nausea and shivering, with frontal headache and great lassitude—"one of my old attacks," the girl called it. The acne disappeared entirely, and the blood showed a most gratifying picture—the bulb was perfectly clear, with none but multinuclear leucocytes present, and the platelets somewhat in excess, due to breaking down of exuberant leucocytes.

Lichen Acuminatis in at least two patients has responded to similar treatment. In these cases a vaccine prepared from the blood was used. One patient showed symptoms of general anaemia, with oedema of lower limbs, constant pain in left hypochondriac region. The skin, after several injections of vaccine, is peeling off, leaving a smooth, epithelial surface, while the general condition is vastly improved.

Another set of skin affections, apparently having their origin in general blood infection, is the herpetic which occurs as a chronic condition by no means rarely. A culture of blood in such a case within the past month has given me a pure cultivation of a bacillus, probably the colon. And this is what one would expect to develop in such a condition where the skin lesion is caused by a localised peripheral neuritis. It has proved very obstinate to ordinary remedies, and has disappeared rapidly after treatment with an autogenous blood vaccine.

Pemphigus is now considered a streptococcal infection, and it also should be treated by a vaccine made either from a fluid in the vesicle or from the blood of a patient.

If this theory of skin disease causation, it should be possible thus to cope with such a malignant affection as pehphigus foliacus, which not only appears on a skin surface, but sometimes on the pharyngeal mucous membrane.

Chronic eczema is dependent, to a great extent, on a general toxemia of some kind. Its relationship to asthma, Bright's disease, etc., is well known. It is in some cases affected by injections of staphylococcic vaccine, and probably would respond rapidly to an autogenous blood vaccine. Alopecia areata is probably the result of a neuritis caused by blood organisms. The presence of organismal growth in the blood in various illnesses is well recognised to-day. Tubercle bacilli, gonococci, pneumococci, streptococci, bacilli anthracis have been demonstrated, and very many tropical diseases have been proved to be due to the presence of haematozoa in the blood corpuscles and blood-forming glands. The blood, therefore, is not the aseptic stream formerly supposed. It will soon be recognised, I am sure, that in city dwellers, at all events, cocci and bacilli—particularly the bacilli colon—can be seen in this blood, and that most anaemias and neurasthenias are due to loss of resistance to these organisms.

The effect of treatment on skin diseases can be seen and appreciated, and certainly an autogenous blood vaccine has given most promising results.

WEIGHING THE EARTH.

By A. E. Blackman.

(Read October 10th, 1910.)

ABSTRACT.

Of the many methods adopted up to the present for accomplishing this, none appear to me to be as free as they might be from many sources of error.

As in all other scientific systems of taking measurements, especially those in which the object of measurement is not directly comparable with our established units, special instruments have to be constructed by which certain measurements are taken, these serving us by the aid of the known laws involved with sufficient data to make calculations from which we derive the answer sought.

This necessitates the selecting of a method out of the possible many at our disposal, which, with the same degree of care taken in those measurements, will lead, all things considered, to the most reliable result.

The less the number of such measurements, and the larger the parts measured (the size of a part here refers to it as a multiple of the smallest portions of it capable of measurement), as a rule, the more dependable must be the result.

From the above considerations I commend the following method:—

Newton's discovery that all particles of matter attract all others by forces varying inversely as the square of their distances leads to the following principles upon which depend the reasons for the special arrangements and calculations necessary to our purpose.

All material bodies attract one another directly and jointly as their masses, and inversely as the squares of their distances.

In effect their masses may be considered concentrated at their centres of mass (centres of gravity) so far as distances beyond their circumferences are concerned, but within their circumferences the law of variation, as far as distances are concerned, depends in homogeneous masses directly with regard to those centres, because anywhere within a spherical shell of matter the forces of the particles of the shell are self-destructive. From this it is evident that a body falling towards the earth is continually acted upon by an increasing force until it reaches in general the surface, after which, if its way were clear to the centre of the earth, the force would fall off to nothing—thus there is a place of maximum force—the effective surface, very approximately sea-level over the ocean, and rising over that level as a comparatively smooth surface over the land, averaging its level.

Now, it is well-known that a pendulum's rate of swing depends upon the force of gravitation and its length as an equivalent simple pendulum—one in which all the matter is supposed concentrated at its centre of oscillation. Take two pendulums synchronised, one placed within a heavy shell—of lead, say—and the other vertically above and immediately outside; the one above experiences the full force of all the matter in the world, provided there be nothing else above its horizontal plane, whereas the one within is deprived of the force due to the mass of the shell. Consequently, the pendulum within loses relatively to that outside.

The weight of the world being some six thousand million billions of tons, any mass we could make use of for our shell would be so extremely small in comparison that the loss of force by its self-destruction, as far as the pendulum within is concerned, can only make a very small difference in its rate of vibration, notwithstanding the fact that the virtual proximity largely compensates—the earth's distance being gravitationally its radius, or, roughly, seven million yards, to the few yards of the shell from the outside pendulum. Thus a mass of a few tons in the shell is virtually many billions of tons in its comparative effect.

By well-known mathematical formulae, after securing the ratio of times of the clocks as indicated by dials and special optical arrangements, we can calculate how many times the quantity of matter in the earth is greater than that in the shell.

To obtain this ratio of times within a reasonable period to any serviceable degree of accuracy, we must adopt methods of measuring the difference of rates of the pendulums by the smallest possible parts of a second.

If the pendulums be arranged to swing in vertical planes at right angles to each other, and if plane mirrors be attached to them, we can optically combine their movements, which combination can be shown to result in an elliptical movement—at quarter phase the axes of the ellipse correspond with the directions of vibration of the pendulums, and their lengths with their effective amplitudes of movement. The changes of form and position of those axes vary with the change of phase, and this can be measured to small fractions of a second by means of photography.

By a suitable arrangement of things, cross wires can be projected upon a very large screen, and can be instantly photographed by means of an electric spark automatically made by one of the clocks.

Carefully adjusted diagrams and measured parts would enable us to measure the loss of the internal clock to many thousandths of a second.

In some period between three and four years there are just one hundred millions of seconds; the clock, whose time is representative of the denominator of the fraction which is the desired ratio of times, could be made to exactly, after registering that number of seconds, record the exact difference of time, at least to within the limits of the possibility of optics, electricity and photography. The pendulum completing the electric circuit at its lowest and fastest position of movement, thus insuring the greatest accuracy of time. The result would be the ratio of times as a decimal fraction, i.e., in its most calculable form.

After explaining the general plan of my scheme, many points of detail require attention.

Since such extreme accuracy in the synchronising of the pendulums is necessary, this must be especially referred to. There can be no real synchronising unless every precaution be taken to ensure the isochronism of each as well—perhaps the technicalities of this can be left. I might mention that the best form of suspension for isochronism is a double spring. The pendulums should be made of materials the least affected by changes of temperature, and be operated in vacuo—the clocks being wound by electricity. The pendulum springs should be of exactly the same strength, the pendulums of identical form, weight, and distribution of the same. The clock trains should be exactly alike, and be driven by the same actual weight—the principle of uniform tension of the driving cord or chain ensuring equal power to the movements, and, consequently, perfectly equal impulse to the pendulums.

The place of experiment should be upon a plain, with no hills, or even tall buildings, above the horizon. There should be no sources of vibration near, such as railways, cart roads, etc. Even the masses of the clock trains, the protecting structures must be considered and gravitationally balanced.

The centrifugal force of the earth's rotation must be allowed for; also we should have to consider the gravitational effects of a periodic character due to the sun and moon at least. There may be yet more disturbing factors to deal with—perhaps the electro-dynamic forces due to the earth's magnetic lines of force.

From an astronomical point of view the gaseous matter is as much a portion of the mass as the liquid and solid portion. Our method does not weigh the atmosphere, this being a spherical shell, within which we must of necessity perform our experiments, its gravitational forces are self-destructive, as far as we are concerned. However, this can be easily figured out and added in. Knowing the area of the surface of the earth, the average pressure at the surface and law of relation between volumes and pressures of gases—Boyle's law—we can easily measure its mass; of course, this is not the mere product of surface and pressure as it would be were the earth's surface a plane.

NEW MARINE MOLLUSCA (PL. XIII., XIV., AND XV.).

By W. L. May.

(Read 21st November, 1910.)

TASMANIAN MARGINELLAS.

Tenison Woods when describing M. cypræoides in these Proceedings for 1877 remarked, "Tasmania is already rich in this genus." If such could be said when the number of species known here was less than a dozen, how much more may it be emphasised when the total, with those I am now describing, amounts to some 40 species?

Recent dredgings in our deeper waters, from 40 to 100 fathoms, have brought to light a great number of new forms, some of which are very distinct species, whilst others vary so greatly in both form and size as to make them exceedingly puzzling. The present paper is an attempt to bring some order out of chaos, and will narrow the work down considerably. In dealing with such a variable group it cannot be hoped that my present work will be final; future discoveries and a larger amount of material may show some of the species to be varieties only. On the other hand some, which I now pass as varieties, may yet be established as good species.

The main difficulty has been with—

1st. The group represented by M. angasi, M. halli, M. shorehami, and M. simsoni, to which are now added M. connectans and M. indiscreta.

There is an almost endless variation between these species, and it might seem superfluous to add more to them, but connectans seems to be the centre of a somewhat fairly defined sub-group distinguished by a generally cylindroid shape, and which seemed to require focussing in a species for general convenience; and indiscreta stands at present at the end of a series in its direction, and remains fairly distinct from its nearest ally. There are several more tolerably distinct forms that are tempting to describe, but I leave them for the present.

2nd. The group represented by M. allporti. Here again the variation is great, and the question whether some of the forms represent species or only varieties is a difficult one. M. kemblensis, Hedley is an intermediate form which has been withdrawn by the author, but I am inclined to let it stand as a species for the present, as it represents a sub-group apparently confined to deep water. I have selected a large form for description, M. gracilis, which is far removed from M. allporti, and considerably so from the nearest connection. Other intermediate, but fairly distinct forms, are left for further consideration.

In addition, I know of several distinct species which cannot yet be dealt with for want of more and better material, and have no doubt that when our waters have been thoroughly searched our total list of species of this beautiful little genus will be at least 50.

I have had the advantage of examining a large series of new forms from South Australia, dredged by Dr. Verco in the deeper waters of that state. Many of those I am now dealing with occur there also, and the variation is even greater, largely owing probably to the much more extensive dredging operations.

I have drawn the figures carefully under the camera lucida, and they gave a faithful representation of the species. The types have been placed in the Tasmanian Museum, Hobart.

MARGINELLA HEDLEYI, N.S.P. (PL. XIII., FIG. 1.)

Shell solid, cylindroid, with a distinct spire, yellowish white, with two distinct orange bands; spire obtuse, whorls four; aperture rather narrow, widening anteriorly; lip slightly thickened, and finely denticulate in the type; some specimens are, however, smooth in this respect; columella convexly curved, with four strong oblique plaits, and a tendency towards a fifth. The two orange colour bands divide the shell into three roughly equal divisions; these bands are always distinct without any shading or accessory bands or lines; there is also a patch of the same colour surrounding the anterior plaits.

Length, 13 m.m.; breadth, 5.5 m.m.

Locality: Type from 100 fathoms seven miles east of Cape Pillar, with a number of others; also from 80 fathoms 10 miles east of Schouten Island.

This might be described as a giant M. mustellina, Angas. It is distinguished from that species by its great size and solidity, and the different colour pattern, which is very constant.

It is a very fine and conspicuous form, which I have much pleasure in dedicating to my friend, Mr. Charles Hedley.

MARGINELLA ALBOMACULATA, N.SP. (PL. XIII., FIG. 2.)

Shell bulbiform, or drop shaped, very solid, glossy; spire quite hidden, the summit of the shell being very broad and dome shaped; aperture as long as the shell, rather narrow, and much curved; outer lips massive, but with a sharp edge; it bends widely out above, but with an inward sweep below, giving it a sinuous outline; it descends in front below the pillar, in joining which it bends far back; well within the lip are numerous obscure rib-like plications; columella very convex, heavily enamelled, and spreading well out over the base of the shell, and bearing six plications, of which the first two are much the largest, the second being the largest of all, and reaching well out over the ventral base; the upper four are much further within the aperture, and become smaller, the last being little more than a small tubercle; colour greyish-white, with about seven revolving lines of obscure elongated white spots.

Length, 6 m.m.; breadth, 4 m.m.

Locality: Type from Frederick Henry Bay in a kelp root, with one other specimen.

This is very distinct from any other Tasmanian species, and seems to belong to the saggitata group.

MARGINELLA ALTILABRA, N.S.P. (PL. XIII., FIG. 3).

Shell pyriform, glossy, white, solid, with a slightly elevated spire; whorls four; aperture narrow, linear; outer lip moderately thickened, mounting the spire about half its height at the junction; it then rises almost to the level of the spire, at the same time curving strongly to the front, giving it a spout-like appearance, and after an outward sweep it descends in a straight line to the square front; within it is very finely and obscurely corrugated; columella with four moderate obliquely ascending teeth, the upper one being almost invisible from a front view.

Length, 5 m.m.; breadth, 2.6 m.m.

Locality: Type 80 fathoms 10 miles east of Schouten Island, with about 50 others; also numerous in 100 fathoms seven miles east of Cape Pillar, and in less numbers in 40 fathoms off Schouten Island. This is a close ally of M. stilla Hedley, Mem. Aus. Mus., Pt. 6, 1903, p. 367, and is perhaps the variety he refers to there. I have collected at least a hundred specimens, which are constant in form; it differs from stilla in its narrower form anteriorly, the very high angle of the lip with its great forward curve, the comparatively weak teeth, and the absence of the strong denticulations on the outer lip.

MARGINELLA GRACILIS, N.S.P. (PL. XIII., FIG. 4.)

Shell biconical, somewhat thin in texture, semi-transparent, with an elevated spire; colour white with orange bands; whorls five, rounded; aperture very narrow above, rather wide centrally, and again narrow at the rounded anterior end; outer lip convex, bearing within a distinct tubercle at one-eighth from the posterior end, and followed by very small irregular crenulations; columella strongly excavate, with four well-developed plaits, at first obliquely ascending, but becoming less so, the upper one being almost at right angles with the pillar. There is a colour band immediately above and below the suture; two broad ones on the body whorl are almost confluent, the upper one reaching above the aperture, and the lower to the last plication; a very narrow band leaves the third plication, and shows in the inner end of the mouth as a bright orange blotch.

Length, 11.5 m.m.; breadth, 5 m.m.

Locality: Type from 100 fathoms seven miles east of Cape Pillar, with several others; also from 80 fathoms 10 miles east of Schouten island. So far it seems confined to deep water.

This species has considerable resemblance to M. kemblensis Hedley, but besides being more than twice as long, it differs in having a sharper spire, in the tubercle being much nearer the posterior end, and the plications reaching a less distance up the more excavate columella.

This is a fine conspicuous form, and resembles M. mayi Tate in size and general appearance, but that species is shorter, broader, and more massive in all respects, and without the characteristic tubercle. It is possible that the colour bands are not constant.

MARGINELLA LODDERÆ, N.S.P. (PL. XIII., FIG. 5.)

Shell fusiform, wih a long spire, very highly polished, yellowish, and faintly banded dorsally; whorls four; apex blunt and rounded; aperture not much more than half the length of the shell, very narrow above, but rapidly widening; outer lip slightly thickened, rounded, smooth; columella concave, with four strong obliquely ascending plaits.

Length, 8 m.m.; breadth, 4 m.m.

Locality: Type from 100 fathoms seven miles east of Cape Pillar, with two others.

Not like any other described species known to me. It also occurs in deep water in South Australia, where there is another unnamed form which is a near relative (Dr. Verco).

MARGINELLA DENTIENS, N.S.P. (PL. XIII., FIG. 6.)

Shell sub-cylindrical, narrow, with a prominent blunt topped spire, pure white, shining, porcellaneous; whorls three (?); aperture narrow, but widening anteriorly; outer lip thickened, curved outside, but straight within, and armed with numerous denticles, which are very irregular both in size and spacing; columella nearly straight, bearing four strong oblique plaits.

Length, 6 m.m.; breadth, 2.5 m.m.

Locality: Type from 100 fathoms seven miles east of Cape Pillar, with several others; also in 80 fathoms 10 miles east of Schouten Island, one specimen.

This appears so far to be a deep water species; it closely approaches in form M. triplicata Tate, but is readily distinguished by the four plaits and strongly denticulated outer lip.

MARGINELLA VERCOI, N.S.P. (PL. XIII., FIG. 7.)

Shell pyriform, broadly shouldered, especially over the aperture, and with a prominent spire; colour pure white and shining; whorls five, rounded; aperture narrow, widening somewhat towards the squared anterior end; outer lip thick, nearly straight, after bending well forward from the shoulder, with about six denticles near the centre of its length on the inner edge; columella somewhat excavate, bearing four plaits, the first with a strong upward sweep from the base, the others less oblique, smaller, and wider spaced as they ascend.

Length, 5.5 m.m.; breadth, 3.5 m.m.

Locality: Type from 100 fathoms seven miles east of Cape Pillar, with many others, some living; also in 80 and 40 fathoms off Schouten Island; many in the former, but less in the latter depth.

This handsome species is very constant in size and form; it has a resemblance to M. lævigata Brazier, which, however, is a much broader and more massive shell, with a shorter spire and mammillated apex. It has also been taken in deep water in South Australia by Dr. Verco, to whom I have much pleasure in dedicating it.

MARGINELLA GATLIFFI, N.S.P. (PL. XIII., FIG. 8.)

Shell broadly pyriform, solid, with a moderately elevated blunt spire, very broad shouldered, but becoming quite narrowed in front; colour yellowish white; whorls three, rounded; aperture moderate, widening slightly towards the rounded front; outer lip massive, heavily varixed, partially ascending the spire, from which it projects at almost right angles to form a broad shoulder, and then bends sharply down with a strong outward curve; from a side view it is also strongly curved towards the front; the inner edge, which is convex, is armed with about seven irregularly spaced denticles; columella roundly convex above, but hollowed in the space occupied by the plaits, which are four in number, rising obliquely, of moderate size, the upper one being the smallest.

Length, 3.3 m.m.; breadth, 2.5 m.m.

Locality: Type 40 fathoms three miles east of Schouten Island, with many others, all dead; also in 60 and 80 fathoms, but becoming few in the deeper water. It resembles M. ochracea Angas, but is a very much broader shell, with a shorter spire. From M. lævigata Brazier, which occurred with it, it differs, besides being only half the size, in considerable difference of outline, in the much more feeble plaits, and far less heavily toothed outer lip. It is also related to M. vercoi, from which, however, it is still more distinct.

Named in honour of Mr. Gatliff, who has done so much for the Victorian mollusca.

MARGINELLA GABRIELI, N.S.P. (PL. XIII., FIG. 9.)

Shell biconical, or fusiform, shining, translucent, but not very thin, with an elevated spire and blunt apex; white, with four orange bands; whorls four, rather rounded; aperture narrow, almost linear, but widening anteriorly, where it is rounded; outer lip moderately thickened and smooth; columella nearly straight, with four well developed plaits, which become smaller and less oblique, and also retreat further within the aperture as they ascend. The anterior band is narrow, and passes between the two upper folds; the second and third in the centre of the whorl are near together, and enter the aperture about its upper third; the fourth is at the suture, and continues on the spire.

Length, 4 m.m.; breadth, 2 m.m.

Locality: Type from 100 fathoms seven miles east of Cape Pillar, with a number of others. A shell of simple character, very constant in form and colour in the type locality; but some examples taken in 15 fathoms in Geography Strait vary from typical, to others which are a uniform rich brown, and somewhat broader and heavier. In South Australia it varies considerably in size, and sometimes loses the colour bands also.

Named in honour of Mr. C. J. Gabriel, an enthusiastic conchological worker.

MARGINELLA CONSOBRINA, N.S.P. (PL. XIV., FIG. 10).

Shell pyriform, or bluntly fusiform; yellowish white, opaque, with a moderately elevated spire, blunt and rounded at the apex; whorls three, rounded; aperture narrow above, but broadening somewhat rapidly to the rounded front; outer lip curved, moderately thickened, and simple; columella convex, with four narrow plaits, the upper one much the smallest, and almost invisible from a front view.

Length, 4.5 m.m.; breadth, 2.5 m.m.

Locality: Type from 100 fathoms seven miles east of Cape Pillar, with two others.

This bears a considerable general resemblance to the last, but is a larger, broader shell. It occurs also in South Australia (Dr. Verco).

MARGINELLA CONNECTANS, N.S.P. (PL. XIV., FIG. 11).

Shell sub-cylindrical, with a short obtuse spire; whorls two or three; dull chalky white; aperture narrow, linear in the upper part, but much wider towards the squared front; outer lip moderately convex, thickened, and simple; columella bearing four plaits, the anterior marginal being strong, the others much smaller, the upper two being widely spaced, and the last one a mere wrinkle.

Length, 3 m.m.; breadth, 1.7 m.m.

Locality: Type from 100 fathoms seven miles east of Cape Pillar, with very many others; plentiful also in 80 and 40 fathoms off Schouten Island.

The above are the dimensions and particulars of the type, which I have selected as intermediary in the variation. It is a very variable form, and it is with some diffidence that I attempt to establish it as a species; the plications may vary from three to five or six, but are often little more than wrinkles; the anterior one is always distinctly the strongest; the spire may be quite hidden when the aperture is as long as the shell. There is also much variation in size, some being scarcely more than 1.5 m.m. in length. The most constant feature is the cylindrical form. This seems intermediary between M. shorehami P. and G. and M. angasi Braz., both of which are approached by some of the variations. It is more cylindrical than either of them, has a straighter aperture and columella than angasi, and a smaller spire, and less broad shouldered form than shorehami, but it may eventually be shown to intergrade with these two species, both of which occurred with it. Plentiful and even more variable in South Australia (Dr. Verco); Western Port, Victoria (C. Gabriel).

MARGINELLA INDISCRETA, N.S.P. (PL. XIV., FIG. 12).

Shell minute, pyriform, with a sunken spire, pure white; aperture as long as the shell, very narrow above, but widening towards the squared front; outer lip moderately thickened, smooth, rising well above the summit of the shell; columella convex, bearing two plaits, the anterior much the stronger; spire deeply sunken, but showing a minute, mammillate apex.

Length, 2 m.m.; breadth, 1.3 m.m.

Locality: Type from 100 fathoms seven miles east of Cape Pillar, with several others.

It is with some hesitation I describe this form, which seems to stand at one end of a variation of which M. simsoni Tate and May occupies the other; however, this is so much removed from the latter, and somewhat decidedly so from the next connection, that it seemed sufficiently distinct to warrant description, but forms increasing in number of plications and exertness of spire are intermediate between it and simsoni.

In its sunken spire and biplicate columella it recalls M. cratericula Tate and May, but in other respects is widely different from that species. It occurs also in South Australia, where the variation is also extremely great (Dr. Verco).

MARGINELLA MICROSCOPICA, N.S.P. (PL. XIV., FIG. 13).

Shell very minute, cylindrical; spire hidden; dull white; aperture as long as the shell; narrow, linear, but expanding anteriorly; outer lip straight, thickened, smooth; columella rather convex, with three oblique plaits.

Length, 1.5 m.m.; breadth, .7 m.m.

Locality: Type from 100 fathoms seven miles east of Cape Pillar, with several others.

This is the most minute species known to me. It is somewhat like M. whani Prit and Gatliff. on a microscopic scale; but in that species, besides the vast difference in size, the aperture bends over the summit to a far greater degree.

II.—The following 14 species, now described as new, are principally from the deeper waters of our continental shelf, where recent dredgings have introduced us to a rich field of which we can have as yet but a very slight acquaintance.

There is not in this assemblage anything extraordinarily new to our fauna with the exception of the shell I have named Daphnella pagoda. This is a striking novelty, and is rather tentatively placed at present; it may require a new genus for its reception. As with the Marginellas I have drawn these figures under the camera lucida, and the types are also placed in the Tasmanian Museum.

PISANIA SCHOUTANICA. (PL. XIV., FIGS. 14-14a.)

Shell yellowish brown, solid, bluntly fusiform; whorls five (plus a small, smooth two-whorled protoconch), rounded, each bearing a strong varix; aperture elongated oval; outer lip curved, sharp at the edge, but backed by a heavy varix; within strongly toothed opposite the ribs; the inner lip spreads a broad band of enamel over the arched columella. Sculpture: The first spire whorl has numerous smooth axial ribs, the second has the same, but the ribs are slightly grooved by obscure depressed concentric liræ; the remaining whorls are strongly cancellated by axial and revolving grooves; in each of the latter is a small keel; the square meshes so produced are each occupied by a round pustule, giving the shell a beautiful granular appearance.

Length, 13 m.m.; breadth, 5.3 m.m.

Locality: Type from 80 fathoms 10 miles east of Schouten Island, with two others immature.

This species has some resemblance to P. reticulata, but besides being only about one-third the length, there is considerable difference in the sculpture, especially on the upper whorls. For comparison I have added a figure of the apical portion of an ordinary example of P. reticulata, drawn to the same scale of magnification.

HEMIPLEUROTOMA ESPERANZA, N.S. (PL. XIV., FIG. 15.)

Shell dull white, high, attenuate anteriorly; whorls six, strongly angular, and including a smooth blunt two-whorled protoconch. Sculpture: A strong keel angles the periphery, another less strong half-way to the lower suture, and a third margins the suture; on the upper slope are two or more faint spirals. Numerous axial liræ cancellate the shell and pass over the keels, rendering them nodulous; they disappear on the lower part of the body whorl, which is occupied by about eight smooth spirals; mouth subquadrate, contracted in front to form a short open canal; outer lip strongly angled at the carena, forming a wide, triangular sinus; below corrugated by the sculpture; inner lip curved.

Length, 5.3 m.m.; breadth, 2 m.m.

Locality: Type from 24 fathoms in Port Esperance; also from 40 fathoms three miles east of Schouten Island; one example. These localities are some 150 miles apart by water. A very distinct little species, slightly recalling M. mayi Verco.

HEMIPLEUROTOMA TASMANICA, N.S. (PL. XIV., FIG. 16.)

Shell solid, rugged, elongate fusiform, dull bluish white; whorls nine, including the protoconch of three whorls, of which the first is smooth and round, the others obscurely axially ribbed; these whorls show little increase in size, giving the shell a mucronate appearance; spire whorls rounded; suture well impressed; aperture obliquely oval; canal open, of medium length; outer lip imperfect; the sculpture indicates a large, shallow sinus at the carina; columella arched above; the enamel of the inner lip spreads well out on the base of the shell. The sculpture consists of two rows of rounded tubercles separated by a depression, but connected by a low axial ridge between each; there is also a roughly nodulous rib below the suture; the nodules are comparatively larger and more distinct on the spire; on the body whorl the lower row becomes increasingly less distinct, and there are several plain keels on the base.

Length, 21 m.m.; breadth, 8 m.m.; length of aperture, 9 m.m.

Locality: Type from 40 fathoms three miles east of Schouten Island, with four others, all imperfect. I have placed it with Hemipleurotoma because of the sinus at the carina, but possibly the canal is somewhat long. It has an obvious resemblance to H. quoyi, from which, however, it is sufficiently distinct, both by its sculpture and the peculiar peg-like apex.

DRILLIA SCHOUTANICA, N.S. (PL. XIV., FIG. 17.)

Shell pure white, turretted, subfusiform; whorls seven, including a blunt protoconch of two smooth rounded whorls; spire whorls convexly angular, girt with a row of distant nodules at the periphery, and a smaller row at the suture, on the lower part of the whorl is a somewhat nodulous keel, and between the two upper rows on the flatly sloping shoulder are four narrow raised liræ. The body whorl has about 15 liræ on the base, the first, opposite the suture, being nodulous; some of these liræ form ridges within the aperture; mouth squarely oval, opening into a short wide canal; lip thin, angled at the upper fourth; in profile it shows a deep trigonal sinus between the suture and the angle, and is then convex; inner lip arched, callously expanding over the columella.

Length, 12.5 m.m.; breadth, 5 m.m.

Locality: Type from 80 fathoms 10 miles east of Schouten Island, with six others. It seems nearest to D. jaffaensis Verco, but is larger, and the sculpture is sufficiently distinct.

DRILLIA SUBVIRDIS, N.S. (PL. XIV., FIG. 18.)

Shell subfusiform, solid; colour greenish white; interior of aperture dark green; whorls 7½, including a protoconch of two smooth rounded whorls. The sculpture consists of numerous strong, smooth, rounded ribs, which are not separated by any intermediate space, and which spring directly from the suture. There are about 15 of these ribs on the penultimate whorl; a deep groove or depression on the upper part of the whorl almost reduces the ribs to vanishing point, above which they reappear with a strong bend towards the left, and give the effect of a row of tubercles at the suture. There is one faint impressed line about the upper third of the body whorl, and a number on the base; aperture short and broad, widely open anteriorly, with scarcely any contraction for a canal; outer lip simple, rounded, with a deep notch at the suture; columella strongly arched; lip broadly expanded over the body whorl, developing a strong callosity where it curves round above the sinus; operculum ovate, with apical nucleus.

Length, 16 m.m.; breadth, 6 m.m.; length of aperture, 6 m.m., but a cotype is 20 m.m. long.

Locality: Type from eight to nine fathoms off Pilot Station, Derwent Estuary, with others; also two very dead and broken from 40 fathoms three miles east of Schouten Island.

This fine species is one of the largest members of the family in Tasmania. It is remarkable that it should have escaped detection so long. It is nearly related to D. woodsi Beddome, but is distinguished by the long straight ribs—not nodulous—and which continue to the suture, although bent by the sinus groove and by its stouter form and much larger size.

MANGILIA SCHOUTENENSIS, N.S. (PL. XV., FIG. 19).

Shell solid, yellowish white, subfusiform; whorls five, rounded, including a large protoconch of two rounded polished whorls; the other whorls strongly ribbed by distant curved ribs, about 12 on the spire; on the body whorl they disappear above the middle. The whole shell is girt by numerous irregularly spaced impressed lines, which pass over the ribs. Mouth elongate, oval, with no contraction for a canal; outer lip thin, curved, with a moderate sinus at the suture, which bends the ribs; columella straight.

Length, 5.3 m.m.; breadth, 2.5 m.m.

Locality: Type from 40 fathoms three miles east of Schouten Island, with 12 others.

A shell of simple character, most nearly related to M. delicatula Ten. Woods, the sculpture of which is similar, but is easily separable by its few whorls and the very different apex.

DAPHNELLA PAGODA, N.S. (PL. XV., FIG. 20.)

Shell fusiform, white, tinted with violet and yellow, particularly between the ribs; whorls 6½, including a rounded, smooth two-whorled protoconch; the three spire whorls spread flatly out from the suture to form a broad shelf, and then curve sharply down and inwards to the base, being far the widest at the angle; strong rounded ribs, about 12 on the first whorl and 16 on the penultimate, extend from the lower suture to the carena, where they form a nodulous ridge, higher than the shelf, and continue obscurely to the suture; five or six insized spirals corrugate the ribs; the body whorl is large, without ribs, but has a number of sharp, distant spiral liræ; the periphery forms a sharp angle, the edge of which is higher than the flat shelf, which is spirally lirate, and crossed by fine curved lines of growth, corresponding with a shallow sinus; mouth oblong, square above, produced anteriorly into a short open canal.

Length, 13 m.m.; breadth, 8 m.m.

Locality: Type from 80 fathoms 10 miles east of Schouten Island, with two others broken.

This is a little gem; its curious and elegant form, combined with a glistening whiteness, and the soft violet tints of the spire, render it a most beautiful natural object. It is so widely different from any other shell known to me that its classification is a matter of doubt. It seemed at present best to consider it a Pleurotomid, and I have placed it in Daphnella. It may require a new genus for its reception.

MITROMORPHA MULTICOSTATA, N.S. (PL. XV., FIG. 21.)

Shell solid, yellowish; elongate oval of five whorls, including a pointed protoconch of two smooth whorls; spire whorls convex; suture well impressed; base contracted; aperture elongate oval, not constricted into a canal; outer lip simple, convex in outline; columella slightly curved; numerous straight rounded axial ribs extend across the whorls, and over about two-thirds of the body whorl there are about 24 on the penultimate; they are separated by deep grooves, which are narrower than the ribs; there is one distinct spiral groove or depression below the suture; numerous faint spirals cross the shell, and are most conspicuous in the grooves; they become much stronger on the base.

Length, 4.3 m.m.; breadth, 2 m.m.

Locality: Type from 100 fathoms seven miles east of Cape Pillar, with three others.

This has a considerable resemblance to M. axicostata Verco, but has more numerous and more closely set and stronger ribs, and far weaker liræ, which latter can scarcely be seen without a lens.

MITROMORPHA SOLIDA, N.S. (PL. XV., FIG. 22.)

Shell solid, elongate, whitish, with a few rusty spots below the suture and on the middle of the body whorl; whorls six, rounded, including a smooth two-whorled protoconch; suture distinct; aperture ovate, scarcely contracted anteriorly, widely open; outer lip rounded, simple, without a sinus; inner lip strongly curved, and simple. On the spire whorls are about 10 strong spiral liræ, separated by slightly narrower grooves; these liræ continue over the body whorl almost to its base.

Length, 9.4 m.m.; breadth, 3.3 m.m.

Locality: Type from 40 fathoms three miles east of Schouten Island, with one other, and from 80 fathoms one example; also from 100 fathoms seven miles east of Cape Pillar three imperfect.

This is a larger and more solid shell than our other members of the genus; it cannot be considered a typical species, and might perhaps be as well placed in Donovonia; it much resembles in form M. pallidula Hedley

TURRITELLA MICROSCOPICA, N.S. (PL. XV., FIG. 23).

Shell minute, straight, rather blunt; colour yellowish brown, smooth, and shining; whorls 8½, rounded, including a protoconch of 1½ whorls, the last turn of which forms a small rounded tip; the lower has a simple groove round the periphery. The spire whorls are encircled by two strong grooves, one at the periphery and the other a little above the suture, and on the upper part by a slight depression; the intervening raised portions are somewhat flattened; aperture subquadrate; outer lip thin, dentated by the sculpture, which shows through the shell within the mouth; columella arched and reflexed; rounded anteriorly.

Length, 3.5 m.m.; breadth, 1 m.m.

Locality: Type from 40 fathoms three miles east of Schouten Island, with 18 others; and in 80 fathoms two examples.

An exceedingly minute Turritella, being in bulk less than half the size of T. smithiana. The sculpture curiously resembles that of Cingulina insignis found with it, and possibly the slight channeling of the mouth may yet place it with that genus.

CINGULINA INSIGNIS, N.S. (PL. XV., FIGS. 24 and 24a.)

Shell very long, narrow, subulate, smooth, glassy, white, clouded with yellowish brown; whorls flattened; 15 in number, including a brown coloured protoconch of three rounded whorls, the last narrowing to an upright point, which is very remarkable and characteristic; sutures well impressed; aperture subquadrate, with a strongly recurved, short, open canal; outer lip simple, very thin, dentated by the sculpture; columella deeply arched above, strongly convex below. Sculpture: Each adult whorl is divided by two narrow square-shaped grooves into three nearly equal flattened divisions; there is a third groove on the body whorl corresponding to the sutures; fine raised growth lines are visible in the lower grooves.

Length, 11.5 m.m.; breadth, 2.8 m.m.

Locality: Type from 40 fathoms three miles east of Schouten Island, with 20 others; also from 100 fathoms seven miles east of Cape Pillar several examples.

A very distinct species, with a remarkable apex. It seems a fairly common shell on our continental shelf.

TURBONILLA TIARA, N.S. (PL. XV., FIGS. 25, 25a, 25b).

Shell long, narrow, solid, yellowish, stained with purple; whorls 15, rounded; the apical portion is very remarkable, suggesting a turban or crown; the last turn is central, and very small, but the adult sculpture continues right over it. There are on the upper whorls about 10 and on the lower 12 strong, straight, rounded ribs, which follow each other regularly up the spire from suture to suture; they are parted by deep furrows of about equal width. The third whorl from the summit is partly smooth and inflated, but a cotype shows no sign of this. I have given a figure of the upper part of both type and cotype to show the difference. The ribs cease abruptly below the periphery of the body whorl, where there is a small keel; another keel encircles the centre of the base, which is smooth, and chestnut in colour; on the centre of the spire whorls is a small obscure spiral ridge, crossing the interspaces, but not seen on the ribs; aperture subquadrate; outer lip curved, varixed, bending back to form a distinct canal; inner lip concavely arched above, convex below.

Length, 9 m.m.; breadth, 2 m.m.

Locality: Type from 40 fathoms three miles east of Schouten Island, with one other juvenile; and in 100 fathoms seven miles east of Cape Pillar two fragments.

Easily separated from our other species by its remarkable apex.

EULIMA EXPANSILABRA, N.S. (PL. XV., FIG 26.)

Shell small, white, smooth, thin, tapering and slightly bent; whorls eight, rounded, the first minute, but increasing rapidly; body whorl inflated; suture well impressed; mouth large, angled above and below; outer lip roundly expanded; columella straightish, well reflexed.

Length, 3.5 m.m.; breadth, 1.5 m.m.

Locality: Type from 100 fathoms seven miles east of Cape Pillar; also from 40 and 80 fathoms east of Schouten Island four examples.

Remarkable for its small spire, large body whorl, and widely expanded mouth.

ACLIS COLUMNARIA, N.S. (PL. XV., FIG. 27.)

Shell small, conical, high, pure white, somewhat hyaline, smooth, and glossy; whorls six, rounded, but widest a little above the suture, which is well impressed; apex blunt and rounded; mouth oval, angled above, round below; outer lip thin and simple, inner lip roundly concave.

Under a high magnification numerous fine spiral grooves are seen on the whorls.

Operculum (in a cotype) light yellow, thin, ovate, pointed above, the nucleus near the middle of the base, with distinct V-shaped lines of growth above.

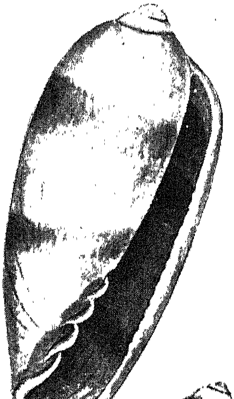
Length, 5 m.m.; breadth, 2 m.m.

Locality: Type from 100 fathoms seven miles east of Cape Pillar, with twelve others.

I have placed this with Aclis because of its strong likeness to A. minutissima Watson from Torres Straits —Challenger Report. It is distinguished from that species by its immensely greater size and the rounded columella.

LIST OF SPECIES.

Marginella hedleyi . . . . Pl. XIII., Fig. 1
Marginella albomaculata . . . . Pl. XIII., Fig. 2
Marginella altilabra . . . . Pl. XIII., Fig. 3
Marginella gracilis . . . . Pl. XIII., Fig. 4
Marginella lodderæ . . . . Pl. XIII., Fig. 5
Marginella dentiens . . . . Pl. XIII., Fig. 6
Marginella vercoi . . . . Pl. XIII., Fig. 7
Marginella gatliffi . . . . Pl. XIII., Fig. 8
Marginella gabrieli . . . . Pl. XIII., Fig. 9
Marginella consobrina . . . . Pl. XIV., Fig. 10
Marginella connectans . . . . Pl. XIV., Fig. 11
Marginella indiscreta . . . . Pl. XIV., Fig. 12
Marginella microscopica . . . . Pl. XIV., Fig. 13
Pisania schoutanica . . . . Pl. XIV., Fig. 14 and 14a
Hemipleurotoma esperanza . . . . . . Pl. XIV., Fig. 15
Hemipleurotoma tasmanica . . . . . . Pl. XIV., Fig. 16
Drilla schoutanica . . . . Pl. XIV., Fig. 17
Drillia subviridis . . . . Pl. XIV., Fig. 18
Mangilia schoutenensis . . . . Pl. XV., Fig. 19
Daphnella pagoda . . . . Pl. XV., Fig. 20
Mitromorpha multicostata . . . . . . Pl. XV., Fig. 21
Mitoromorpha solida . . . . Pl. XV., Fig. 22
Turritella microscopica . . . . Pl. XV., Fig. 23
Cingulina insignis . . . . . . Pl. XV., Fig. 24 and 24a
Turbonilla tiara . . . . Pl. XV., Fig. 25, 25a, 25b
Eulima expansilabra . . . . Pl. XV., Fig. 26
Aclis columnaria . . . . Pl. XV., Fig. 27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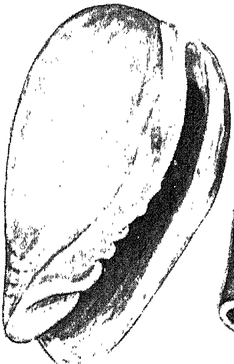
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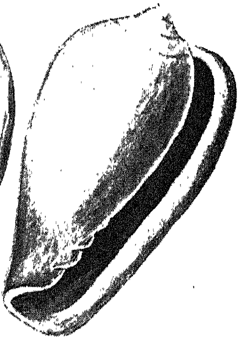
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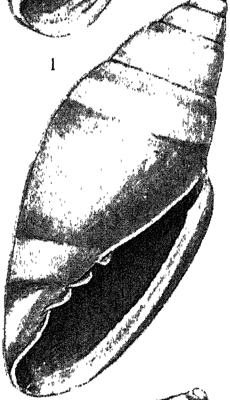
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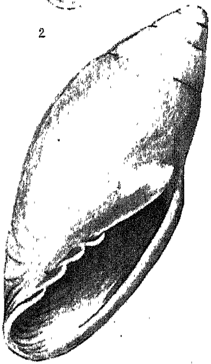
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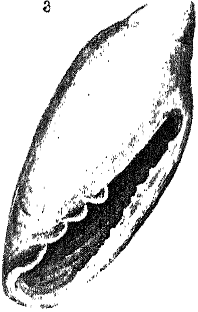
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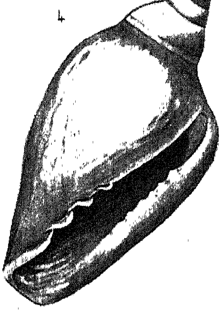
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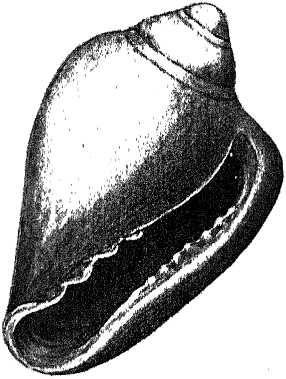
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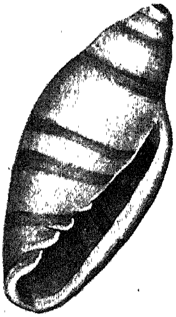
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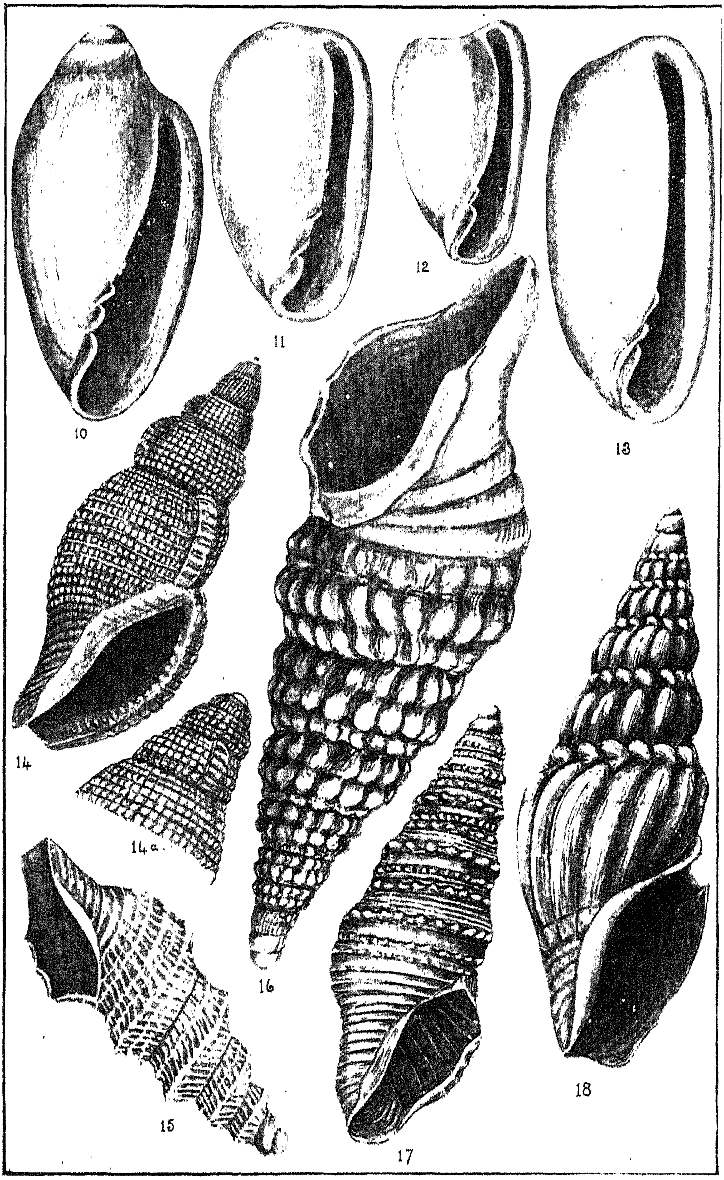
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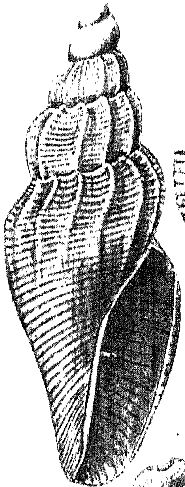

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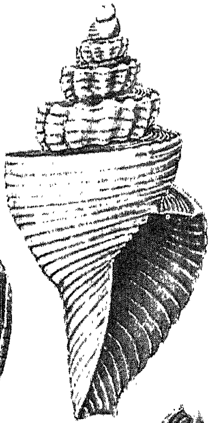

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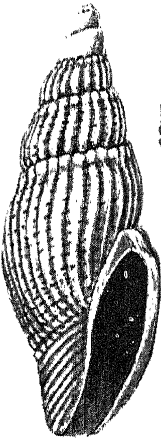

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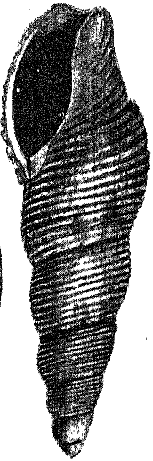

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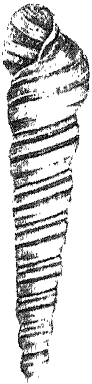

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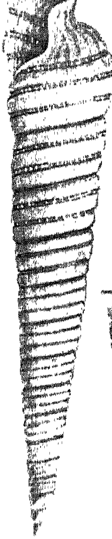

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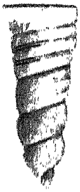

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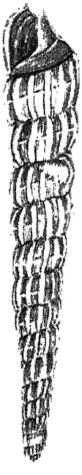

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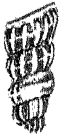

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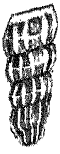

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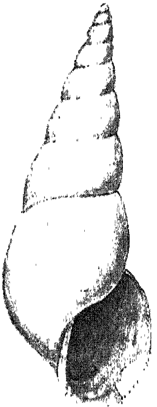

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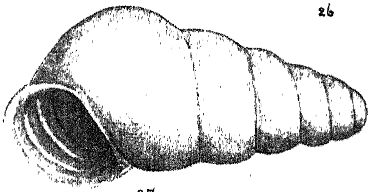

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REPORT

OF THE

ROYAL SOCIETY

OF

TASMANIA

FOR THE YEAR

1910.

Hobart.

Printed at "The Examiner" Patterson Street, Launceston

1911.

Annual General Meeting.

The Annual General Meeting of the Royal Society was held in the Society's rooms, Museum, on Monday, 6th March, 1911.

His Excellency the President (Sir Harry Barron, K.C.M.G., C.V.O.), occupied the chair, and the Annual Reports for 1910 were submitted.

ANNUAL REPORT FOR 1910.

The Council of the Royal Society have the honour to present their Report for 1910 to the Annual General Meeting of the Society.

Eight monthly General Meetings, two special General Meetings, and a conversazione were held during the year. Ten Ordinary Meetings and nine Special Meetings of the Council were held during the same period.

Twelve Fellows and one Associate were elected, while seventeen Fellows with one Associate left the State or allowed their membership to lapse.

Th total number of the Fellows of the Society were 140, including nine Life Members. The number of Corresponding Members is 35, but the list requires early revision.

We regret to have to announce the death of His Majesty King Edward VII., Patron of the Society; also since the Annual Meeting the death of Mr. Bernard Shaw (Chairman) and Dr. G. A. Webster (a member of the Council).

Mr. Shaw was elected to the Council in 1894, and since that date had taken an active part in the interests of the Society.

Mr. Thos. Steele and Mr. Leonard Rodway were elected to take the place of Mr. Shaw and Dr. Webster.

A vacancy in the Council, caused by the resignation of Mr. Russell Young, sen., was filled by the election of Mr. Russell Young, jun.

During the year Mr. W. F. Petterd, an active member of the Society, died. Under the terms of his will he bequeathed to the Society his collection of minerals, valued for probate at £1,212.

The Society has agreed with the Trustees of the Tasmanian Museum that this valuable collection be properly exhibited in the Museum.

The Council received a deputation from members of the Medical section of the Society presenting a request that the Tasmanian section of the British Medical Association, under-going formation, be permitted to affiliate with the Royal Society of Tasmania. The request was granted subject to certain conditions.

During the year 723 volumes, parts of volumes, and memoirs have been presented to the Society, mostly in exchange for our annual volume of Papers and Proceedings.

Of this total the Academy of Science, Vienna, contributed 118 in one parcel, being numbers since 1902; mathematical, physical, and biological.

The Mines Department of Tasmania donated a set of their Annual Reports from 1885 to the present date, less 1889.

The exchange list of the Society totals 77 societies and Government departments at home and abroad.

The following Papers were read during the Session of 1910:—

- Notes on the Publications of the Royal Society of Tasmania, by Fritz Noetling, M.A., Ph.D.
- The Antiquity of Man in Tasmania, by Fritz Noetling, M.A., Ph.D.
- On certain Types of Stones used by the Aborigines, by H. Stuart Dove, F.L.S.
- Comparison of the Tasmanian Tronatta, with the Archaeolithic Implements of Europe, by Fritz Noetling, M.A., Ph.D.
- The Food of the Tasmanian Aborigines, by Fritz Noetling, Ph.D.
- Additions to the Catalogue of the Marine Shells of Tasmania, by W. L. May.
- The Distribution of Australian Land Birds, by Robert Hall, C.M.Z.S.
- The Norman Manuscript of Tasmanian Antiquities, by H. B. Ritz, M.A.
- Notes on Eucalyptus Risdoni, by L. Rodway.
- Notes on the Genus Lissotes, with descriptions of New Species, by A. M. Lea, F.E.S.
- Skin Diseases treated by Blood Vaccine, by E. W. J. Ireland, M.B., C.M.
- Weighing the Earth, by A. E. Blackman.
- New Marine Mollusca, by W. L. May.

A Balance-sheet duly audited showing the receipts and expenditure for 1910 is appended.

The Report was adopted without amendment.

ELECTION OF MEMBERS OF COUNCIL.

The following Fellows were duly elected:—Messrs. Samuel Clemes, John A. Johnson, M.A., Thomas Steele, and Dr. Purdy.

VICE-PRESIDENTS.

His Excellency nominated the Hon. Dr. G. H. Butler and Robert Mackenzie Johnston, I.S.O., as Vice-Presidents.

ELECTION OF FELLOWS.

Messrs. W. Reid Bell, C.E.; A. M. Lea, F.E.S.; and Colonel J. W. Parnell, R.A.E., were elected Fellows of the Society.

AUDITOR.

Mr. H. W. W. Echlin was reappointed Auditor.

REPORT OF SECTIONS.

The Medical section reported through their Secretary (Dr. E. W. J. Ireland) that the section during the past twelve months has had a membership of eighteen.

During the year the Annual Meeting, six ordinary meetings, a special, and a committee meeting were held.

The annual dinner of the section was celebrated in October, when three officers from the Netherlands fleet were present as guests.

The periodicals subscribed to were:—"Lancet," "British Medical Journal," "Journal of the American Medicine Association," "Practitioner and Medical Review."

The following works were added to the Library:—Lejar and Dickie's Urgent Surgery, Haig on Uric Acid, Allen Vaccine Treatment, Human Parasites by Leuckart, and the Medical Directory for Australia.

THE ROYAL SOCIETY OF TASMANIA.

RECEIPTS AND EXPENDITURE, 1910.

GENERAL ACCOUNT.

RECEIPTS.				£	s.	d.
909.						
alance, 1909				£107	8	3
910.						
ubscriptions—107 Fellows at 30s.	£160	10	0			
24 Country do., 20s.	24	0	0			
1 Associate	0	15	0			
Arrears and Exchange	1	0	3			
				186	5	3
ield Naturalists' Club—						
Rent of Room				6	10	0
ale of Copies of Proceedings				2	9	6
etterd Collection of Minerals—						
Subscription for Cases	107	0	0			
Do. Cost of Classification	6	0	0			
				113	0	0
				£415	13	0

I have this day examined the ooks and Vouchers of The Royal ociety of Tasmania for the year 10, and found them correct and in cordance with the Balance Sheet.

H. W. W. ECHLIN.

obart, February 4, 1911.

1910. EXPENDITURE.				£	s.	d.
Grant to Medical Section				12	0	0
Salaries—Secretary	£50	0	0			
Attendant	9	5	0			
				59	5	0
Papers and Proceedings—						
Printing, 1909	£78	10	0			
Do., 1910	6	8	0			
Postage, etc., Vol., 1909	4	9	8			
				89	7	8
Library—						
Books and Magazines	£19	15	2			
Do. Binding	4	19	0			
Insurance, £2,000	4	10	0			
				29	4	2
Expenses of Meetings, Fire, and Gas	£2	6	4			
Printing and Advertisements	5	1	0			
Refreshment	4	0	0			
				11	7	4
Expenses Conversazione				12	7	10
Law Cost re Stokell and Knopwood Diary				5	14	3
General Expenses—						
Auditor	£1	1	0			
Painting Society's Room	3	0	0			
Gas Pendant for do.	1	5	0			
Petty Cash and Sundries	11	10	0			
Bank Charge and Cheque Book	0	15	0			
				17	11	0
Duty on Petterd Collection of Minerals				121	4	0
Balance				57	11	9
				£415	13	0

Balance, £57 11s. 9d.

THE MORTON-ALLPORT MEMORIAL FUND ACCOUNT.

	£	s.	d.		£	s.	d.
Dec. 31, 1909.				Dec. 31, 1910.			
To Balance	0	4	7	By Balance	9	7	1
„ Interest from Trustees	9	2	6				
	£9	7	1		£9	7	1

LIFE FELLOWS' COMPOSITION FEES ACCOUNT.

	£	s.	d.		£	s.	d.
Dec. 31, 1909.				Dec. 31, 1910.			
To Balance	1	0	0				
Dec. 31, 1910.							
To Balance	£1	0	0	By Balance	1	0	0

E. L. PIESSE,
Acting Honorary Treasurer.

January 9, 1911.

LIST OF FELLOWS AND ASSOCIATES

OF THE

ROYAL SOCIETY OF TASMANIA.

---

*Fellows who have contributed Papers read before the Society.
†Life Members.
The addresses of Members residing in Hobart are omitted.

Agnew, L. E., Mrs.
Allwork, F., L.S.A., *New Norfolk.*
Archer, Wm. Henry Davies, *Longford.*
Anderson, G. M., M.B., C.M., *Franklin.*
Armstrong, Hugh, F.R.C.S.
Ash, Percy.

†Baker, Henry D.
Barclay, David.
†Baring, Rev. F. H., M.A., F.R.G.S., *Spring Bay.*
*Beattie, J. W.
Bennett, William Henry, *Ross.*
Bennison, Thomas.
Bidencope, Joseph.
Black, John.
Blackman, A. E.
Brain, Rev. Alfred, M.A.
Brownell, F. Leslie.
Burgess, Hon. Wm. Henry.
Butler, Arthur, *Lower Sandy Bay.*
Butler, Francis.
Butler, Hon. Gamaliel Henry, M.R.C.S., M.L.C.
Burbury, Fredk. E., *Launceston.*
Butler, W. F. D., M.Sc.

Campbell, R. D., M. B.
*Clarke, Arthur H., M.R.C.S.
Clemes, Samuel.
Clemes, William H.
Clerke, Claude.

Counsel, Edward Albert.
Crouch, Ernest J., M.R.C.S.
Cruickshank, James H., Lt. Col. R.E., *Glenorchy*.

Davies, Sir John George, K.C.M.G., *New Town*.
Davies, Hon. Charles Ellis, M.L.C.
Dechaineaux, Lucien.
Delany, His Grace Archbishop.
*Dobson, Hon. Henry.
Donovan, T. Matthew, L.R.C.P., L.R.C.S., *Sorell*.
Dove, H. Stewart, *West Devonport*.
Ernst-Carroll, F. J., M.Sc., *Neuchatel, Switzerland*.
Evans, Thomas May, Col.
Ewing, Hon. Norman K.

Fereday, Mrs. R. W.
†Foster, Henry, Major.
†Foster, John D.
Finlay, W. A.
*Flynn, T. Thomson, B.Sc.

†Grant, C. W.
Giblin, Lyndhurst F., B.A.
Giblin, Wilfred, M.B.
Gould, Robert, *Longford*.
*Green, A. O.
Gould, H. T.
Gurney, George A.

Harrison, E. J., *Bellerive*.
Harrison, Malcolm.
Harvey, Walter A., M.R.C.S., M.B.
Hogg, G. H., M.D., *Launceston*.
Holt, Henry.
Horne, William.
Hutchison, Hermann.

Ireland, E. W. J., M.B., C.M.

*Johnson, J. A., M.A.
*Johnston, Robert M., F.L.S., I.S.O.

Kerr, George.
Knight, H. W.

Lake, W. Spencer, M.Sc.
*Legge, Vincent W., Col., R.A., *Cullenswood*.
Lewis, Lieut.-Col., R.C.
Lewis, Hon. Sir Neil Elliot, D.C.L., M.A., K.C.M.G.
Lines, D. H. E., M.B.
Lodder, Miss M., *Launceston*.

Mason, M.
†Mitchell, J. G., *Jericho.*
*May, W. L., *Sandford.*
Mercer, E. J., Dr. (Bishop of Tasmania).
Miller, Lindsay S., M.B., Ch.B.
Millen, J. D., *Waratah.*
*Moore, George Brettingham, C.E.
†McClymont, J. R., M.A., *Queenborough.*
*McAulay, Professor Alexander, M.A.
McElroy, J. A.
Macfarlane, Hon. James.
Macgowan, E. T., M.B., B.S.
*Macleod, P. J., B.A.

Nicholas, George C., *Ouse.*
*Noetling, Fritz, M.A. Ph.D.
Norman, Keith, LL.B.
Norman, Harold F.
Nicholls, H. Minchin.

Parker, Major A. C.
Parsons, Miss S. R.
Payler, Rev. Morgan.
Pearce, E. H., J.P.
Pedder, Alfred.
*Piesse, E. L., B.Sc., LL.B,
Pillinger, James.
Pratt, A. W. Courtney.
Purdy, J. S., M.D., D.P.H.

Reid, A. R.
*Ritz, H. B., M.A.
Roberts, E. J., M.B.
Roberts, Henry Llewellyn.
*Rodway, Leonard.

Salier, Douglas.
†Sprott, Gregory, M.D.
Steele, Thomas J.
†Sticht, Robert, B.Sc., E.M., *Queenstown.*
Scott, H. H., *Launceston.*
Scott, Robert G., M.B., C.M.
Shaw, Bernard, I.S.O.
Shoobridge, Rev. Canon George.
Shoobridge, W. E., *Glenora.*
Sich, Hugh H., *Malvern, Victoria.*
Simmons, Matthew W.
*Simson, Augustus, *Launceston.*
*Stephens, Thomas, M.A., F.G.S.
Seal, Leonard P., *Shene.*

Tarleton, John W.
*Taylor, A. J.
Toovey, C. E.
*Twelvetrees, W. H., F.G.S., *Launceston.*
Walch, Charles.
*Ward, L. Keith, B.A., B.E.
Watson, Horace.
Watchorn, Arthur Denison.
Watchorn, E. T., Lieut.-Col.
Webster, Alexander George.
Webster, C. Ernest.
Webster, George A., M.B., M.R.C.S.
*Weymouth, W. A.
Winter, Alfred.
Wise, H. J.
Wolfhagan, J. Edgar, M.B., C.M.
Wolfhagan, Waldemar.

Young, Russell
Young, Russell, Junior.

ASSOCIATES:

Lea, Arthur M., F.E.S.

Note.—Fellows are requested to notify any errors in their names, titles, or addresses.

I. A. R. I. 75.

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